American Machinist

Volume 64 New York, June 10, 1926 Number 23

A Permanent Machine Tool Exhibit

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Proposed outline for the section on machine tools and shop practice of the Museum of the Peaceful Arts

FOR many years there has been a widespread feeling of need for a Museum in this country covering the field of Machine Tools and Machine Shop Practice.

Granting the field is covered adequately, such a Museum should be part of a broader one covering the whole field of industrial arts, because the machine tool industry exists primarily to supply other industries with means of production and transportation. Such a Museum should be more than an aimless collection of historical machines brought together without method or system. It should make a strong appeal to the average person, quicken interest and educate unconsciously. In addition it should offer the best of facilities for those making special studies in this field. To do this, the exhibits must be deliberately and carefully

Table I—Breakdown of Divisions Into Classes

Machine Tool and Shop Practice Section, Museum of the Peaceful Arts

DIVISION I

Elements of Machines and Machine Shop Practice

(See Table II for breakdown of each class)

Class

1. Hand Tools — Primitive implements, machinist's tools, carpenter's tools
2. Cutters—Steels used, single edged lathe-planer types; milling cutters, drills, reamers, forming tools, wood-working tools, etc.
3. Grinding—Flat and Rotary, soft stone, hard, disk, buffing, polishing, etc.
4. Slide Rests—Evolution and modifications, Turret principle
5. Chucks, Clamping Devices—General principles of jigs and fixtures
6. Screws—Types of thread, with their uses, methods of making, taps, dies, lead screw, milling, etc.
7. Gears—Early types, tooth forms, spurs, bevels, worms, etc.
8. Cams—Different types with their uses
9. Power Transmission — Shafting, hangers, plain, self-oiling and roller bearings, pulleys, clutches, etc.
10. Hoists and Cranes
11. Measuring—Scales and end measurements, micrometers, verniers, limit, profile, position, dial gages, etc., optical methods
12. Methods of Generating Surfaces —With examples of application

DIVISION II

Machine Tools and Standard Production Machinery

(See Table III for breakdown of each class)

Class

1. Lathes
2. Boring Mills and Boring Machines
3. Planers, Shapers, Slotters, Rifling Machines
4. Milling Machinery
5. Drilling Machinery
6. Broaching Machines
7. Grinding Machinery
8. Gear Cutting Machinery
   Formed-tooth, template, generating, hobbing, etc., for spur, bevel, and worm gearing
9. Presses, stamping and cold-drawing machines, punches and shears, rolling, bending
10. Forging Machinery
    Steam and power hammers, drops and die forging, hot rolling, swaging, extrusion, wire drawing, etc.
11. Foundry Equipment and Methods
    patterns, furnaces, molding machines, cleaning, etc.
12. Heat Treatments, Hardening, Tempering, Pyrometry
13. Welding Equipment and methods, Flame cutting, Brazing, Soldering, etc.
14. Wood working machinery
15. Certain special classes, as pin, needle, ball, tack and watch machinery

DIVISION III

Old Shops

1776—Hand Tools Era—
Showing whip lathes, post drill, forge, small cupola, etc., and workmen making house hardware, agricultural tools, kitchenware

1800—Beginnings of Specialization
Showing templates, filing jigs, head-stock lathe, candles

1820—Milling Machine, drills, gages, Blanchard lathe, back geared lathe, candles or whale-oil lamps

1840—Planer, shaper, jigs, lead-screw lathes, kerosene lamps

1860—Colt and Robins and Lawrence Shops, Lincoln Millers, Hand turret lathe,—gas lighting

1880—Automatic lathes, etc.
Gas lighting

1900—Multi-spindle lathes, etc.
Electric lighting

1920—Broaching, precision grinding
Motor driven tools and enclosed gearing, etc.

The aim in each case will be to give a picture, historically correct in every detail, of the conditions surrounding the workmen of that day

chosen, and presented in a way to bring out their relative importance and historical sequence. Historical exhibits should be used wherever possible and helpful, because of their strong sentimental appeal, but the main purpose should never be lost, namely, to give a consistent picture of the development of the art. This means that sectional reproductions, working models, photographs, etc., should be freely used if they serve the main purpose.

The splendid bequest of Mr. Henry R. Towne, of the Yale & Towne Manufacturing Company, makes such a museum possible. In his will, Mr. Towne outlines a noble plan for Museums of the Peaceful Arts which will set forth the development of these arts and more particularly the contributions of America in the various fields. His plan is so broad that it will require years of growth for its full development, but when realized, it will provide in New York City a Museum capable of rendering a service not only to the City but to the whole country, comparable in this field to that of the Metrolopitan Museum of Fine Arts and the Museum of Natural History in their respective fields.

Realizing that even his generous gift would do little more than make a start, Mr. Towne suggested that the most fitting industry for the first unit should cover the field of "machine tools, an industry," to quote the words of his will, "of which this country is the acknowledged leader, for these constitute a chief part of the equipment of many other industries, and are the means whereby all the equipment of many other industries are produced." In accordance with this wise direction, the Trustees are proceeding to establish such a section. As a first step, a broad plan is being developed that will give a consistent, orderly presentation of the field, so that the exhibits as they are acquired may fit into a unified presentation of the industry and its history.

This plan as it now stands, divides the field into three main divisions as follows:

Division I. *Elements of Machines in Machine Shop Practice.* Machine tools are largely combinations of a few standard elements which appear in many types of machines. Each of these elements has a history and technique of its own which can be shown from primitive forms down to the latest practice.

Division II. *Machine Tools and Standard Production Machinery.* To be grouped under major types, to show the history of each type through its significant stages down to current practice, and to bring out the work for which each type is adapted and the reasons therefor.

Division III. *Old Shops.* Being a series of rooms fitted up with the machines, hand tools, shafting, lighting, etc., characteristic of significant periods. In this way, the relative age of the different types of machinery and the conditions under which machine work has been done, will be brought out.

The proposed break-down of these divisions into classes is given in Table I. The tentative division of the above classes into groups is given in Tables II and III.

It will be noted that Division I deals with the elements of machines, Division II with the grouping of these elements into working machines, and Division III with the broader grouping of the machines into the shop as a whole. All those who have been consulted are especially interested in this third division, feeling that it will bring out and emphasize working conditions, and that human element for which all industry has existed and must exist.

The outline given above is tentative and open to suggestions and improvement, either through substitution or additions.

The *American Machinist* has generously offered to help in bringing it to the attention of its readers. This is done for the purpose of inviting, first, constructive criticism on the broad scheme and on the elements of the sub-divisions, their proper balance, omissions, etc., second, information as to data, drawings, old pictures, descriptions, photographs, and possible exhibits which would be helpful in building up the museum and, third, and most valuable of all, the gift or loan of actual exhibits—either machine tools, old hand tools or any other significant element in the development of machine shop practice.

It is felt that scattered throughout the country there is a large body of material in the shape of old equipment, old drawings, descriptions, advertising matter, etc., which is rapidly disappearing, and any who are interested in the preservation of this material and in the purpose of this museum are invited to communicate with the Museum of the Peaceful Arts, Room 917, Engineering Building, 29 West 39th Street, New York City. Any help which can be given either in the form of suggestions, information, or exhibits, which will strengthen the presentation of this field, will be greatly appreciated. The aim is, if possible, to make this section the most unique and useful of its kind in the world.

Table II—Breakdown of Classes Into Groups, Division I

Machine Tool and Shop Practice Section, Museum of the Peaceful Arts

CLASS 1—Hand Tools

Group

1. Primitive implements—stone, bronze, iron
2. Evolution of wood working hand tools—such as Hammers, chisels, saws, auger, plane, adz and axe, etc.
3. Evolution of metal working hand tools—such as Hammer, chisel, file, scraper, etc.
4. Hand Tools for working other materials

CLASS 2—Cutters

Group

1. Hand Tools, used on machines, such as chasers, old finishing tools, wood turning tools, etc.
2. Cutting Steels
   History, characteristics, performance, special uses
3. Lathe-planer Cutting Tools
   Types and shapes, cutting angles, chip action, wear, forming tools, tool holders for high speed steel, etc.
4. Milling Cutters
   Evolution of milling cutters, plain, spiral, formed, gang tools, inserted teeth, cutting angles and methods of relieving and taking up wear
5. Drills
   Old forms, flat, fluted and twist drills, boring bars, deep hole drilling, wood drills, cutting angles, relief, effects of bad grinding, etc.
6. Punches and Dies
   Types and action
7. Reamers
   Plain, taper, solid, adjustable, expansion, shell, use, etc.
8. Tools for wood working machinery
9. Special Types of Tools

CLASS 3—Grinding

Group

1. Grinding materials—magnified views of the grains and cuttings to show action—effect of different binders, etc.
2. Flat stones—uses. Old grinding methods

3. Rotary—soft stones, hard stones, emery, aluminum oxide, etc. Methods of manufacture, shapes and sizes of wheels, methods of mounting, safety flanges and hoods, effects of wheel failures, methods of balancing
4. Buffing and Polishing wheels
materials used, methods of mounting, various polishing agents

CLASS 4—Slide Rests

Group
1. Early forms
2. Evolution of the Apron
3. Evolution of cross-slides and planer heads
4. Turret heads—3 fundamental positions
5. Slide rests for grinding operations

CLASS 5—Chucks, Clamping Devices, Jigs and Fixtures

Group
1. Face plates and face chucks
2. Expanding chucks, mandrils and collets, air operated chucks
3. Clamping devices, machine vises, etc.
4. Electric chucks and clamping devices
5. General principles of jigs and fixtures

CLASS 6—Screws

Group
1. Origin and Evolution
2. Types of Sections—V, square, U. S., Whitworth, Buttress, Acme, etc., with samples of sizes
3. Early methods of making—paper template, two wire, angular chasers, etc.
4. Early taps and dies
5. Lead screw methods—separate screws, one screw and change gear
6. Taps—solid, collapsing, rolling, inserted cutters, etc., methods of relief and sharpening
7. Dies—Ditto
8. Thread milling
9. Thread rolling
10. Production of precision screws

CLASS 7—Gears

Group
1. Historical development—old pin and lanterns, etc., old clock gearing, wooden teeth, etc. Evolution into the modern mathematical forms, cycloid and involute, etc.
2. Models showing theory and advantages of correct forms—principles of interchangeability, rolling contact, etc., limits to shape, number of teeth, etc.
3. Types of gears—spurs, annular, plain and spiral, etc., bevels, miters, plain and spiral worm gears, Hindley, etc., hyperbolic, etc.
4. Special Types—shrouded, herringbone, leather, Bakelite
5. Gear trains, gear reductions, differentials, etc.

CLASS 8—Cams, Types and Use

Types of cams, cylindrical, edge, face, etc., with their uses. Examples of applications

CLASS 9—Power Transmission

Group
1. Shafting and couplings
2. Hangers, plain, self-oiling, roller, ball, thrust bearings, etc.
3. Speed reductions, cones, hydraulic, etc.
4. Pulleys, C. I., Steel, Wood.
5. Belting—Leather, rubber, cotton, methods of lacing, link belts, silent chains
6. Clutches, Jaw, friction, disc and multiple, cone
7. Universal joints. Hooke's, Oldham, etc.

CLASS 10—Hoists, Cranes, and Shop Transportation

Group
1. Pulleys, windlasses, winches, etc.
2. Hoists, differential, spur geared, worm, air, etc.
3. Cranes—jib, traveling, etc.
4. Overhead trolley systems
5. Trucks, hand, power, electric, elevating, etc.
6. Conveyors, etc., as used in assembling and other shop operations

CLASS 11—Measuring

Group
1. Linear—Scales and end measurement, Johannsen, and Whitworth, feelers, micrometers (with history, as Gascoigne, Watt, etc.), verniers, optical methods, Hartness optical comparators, interferometer, dial gages, Prestwich type, etc.
2. Angular—Protractors—precision types, optical
3. Dividing engines, linear and angular
4. Gages—Plug and Ring—plain and limit, star gages
Position and contour
Snap gages
Optical type
Surface gages
Angle gages
5. Hardness—old methods, Brinell, Scleroscope
Pressure
Weight
Thermometry

CLASS 12—Methods of Generating Surfaces

Charts and models of the methods by which various surfaces may be generated, with examples of the practical use of each, for example, a cylinder which can be planed as in a shaper, turned spirally as an ordinary lathe cut, or by radial feed of a broad faced tool, etc.

Table III—Breakdown of Classes Into Groups, Division II

Machine Tool and Shop Practice Section, Museum of the Peaceful Arts

CLASS 1—Lathes

Group
1. Potter's Wheel
2. Primitive Chinese, Indian lathes
3. Early forms, whip lathes, continuous, cord around work and with head stock
4. Besson's early French lathe, etc.
5. Maudslay's triangular-bar bed, slide-rest, lead screws
6. Roberts' first back gears
7. Development of head stock, hollow spindle, face plate, etc.
8. Development of apron, cross slide and tool-holder
9. Development of change gears, lead screw, and modern changegear, etc.
10. Development of beds, and ways
11. Development of tail stocks
12. Development of boring bars
13. Special types, as Fox, double-headed, etc.
14. Hand operated Turret lathes—Development and types, 3 positions of turret, flat turret, box-tools, pilot bars, etc.
15. Automatic Turret lathes—development and types, principles of cam control for cutting operations and feeding
16. Multi-spindle lathes—Development and types
17. Lathes for irregular shapes, Blanchard, etc.
18. Lathe fixtures, box tools, etc.

CLASS 2—Boring Mills and Boring Machines

Group
1. Nicholas Forq—1740
2. Smeaton's—1750
3. Wilkinsons'—1775
4. Bodmer—1840
5. Bullard Vertical Lathes, Bement, Niles—Mult-au-matic, etc.
6. Horizontal boring machines—Lucas, etc.
7. Portable boring machines
8. Boring mill fixtures

CLASS 3—Planers, Shapers, Slotters, Rifling Machines

Group
1. Forq—1740
2. Roberts—1817
3. Old Chelmsford Planers, stone bed, chain drives
4. Clements "great" planer
5. Styles of drive, spiral, etc., and of housings, as open side, etc., crank planers
6. Large planers—with moving heads
20. Nasmyth "Steam Arm"

21. Whitworth quick return—different types of quick return
22. Pilar shapers, etc.
23. Modern types—draw-cut shapers, traveling head shapers
24. Slotters and Key-seaters
30. Rifling machines
31. Drill fluters

CLASS 4—Milling Machines

Group
1. Whitney Milling Machines
2. Gay-Silver Milling Machines
3. Nasmyth
4. Robbins and Lawrence and Lincoln Millers
5. Howe "Universal" Miller
6. Brown and Sharpe Universal—Column and Knee types
7. Profilers
8. Hand Millers
9. Automatic Millers
10. Briggs type
11. Vertical millers and die sinkers
12. Index Heads
13. Thread and long spiral miller
14. Ingersoll or planer type
15. Rotary planer
16. Milling fixtures

CLASS 5—Drilling Machines

Group
1. Primitive—Burning holes by hot rods, by friction, etc.
2. Primitive—Bow string and Chinese drills
3. Old Post drills, and evolution into modern single spindle uprights for drilling and tapping
4. Sensitive drills—disc drives, etc.
5. Portable drills, air and electric drills, etc.
6. Radial drills—half and full universal drills
7. Multiple drills
8. Drilling jigs and fixtures

CLASS 6—Broaching Machines

Group
1. Early forms
2. La Pointe type
3. Hydraulic
4. Types of Broaches, Holders and work done

CLASS 7—Grinding Machines

Groups
1. Old grinders—soft stones
2. Evolution of modern wheel stands
3. Surface grinders
4. Cylindrical grinders—plain and universal
5. Internal grinders
6. Gear grinders
7. Tool and cutter grinders
8. Disk grinders
9. Chucking grinders
10. Polishing and Buffing stands
11. Cam grinders
12. Portable grinders
13. Grinding fixtures

CLASS 8—Gear Cutting Machinery

Group
1. Different principles used for cutting spur gears
   (a) Formed milling cutter
   (b) Describing generating
   (c) Form generating
   (d) Template principle
2. Spur gear milling machine — Brown and Sharpe — Gould and Eberhardt, etc.
3. Spur gear planer—Gleason, Newton, etc.
4. Gear shaper
5. Hobbing machines
6. Bevel gear cutters—Plain, former type, generating type, etc.
7. Cutting spiral spurs and bevels
8. Cutting worms and worm wheels

CLASS 9—Presses, Stamping and Cold-drawing Machines, Punches, Shears

Group
1. Types of punching and forming dies with samples of work, carried through progressive operations
2. Sub-press dies for precision work
3. Foot presses
4. Open presses
5. Pillar presses—crank, and knuckle-joint
6. Types of feed—cut and carry, dial, etc.
7. Punches
8. Shears
9. Safety devices

CLASS 10—Forging Machinery

Group
1. Old types of power hammers, tilt, etc.
2. Evolution of power hammers, with dies and samples of work—Bradley, Beaudry, Pneumatic, etc.
3. Drop hammers, with dies—screw, belt, board, steam. Samples of work in progressive stages
4. Steam hammers
5. Hydraulic forging presses—models
6. Headers and Upsetters
7. Rolling Mills and Rolling Machines
8. Wire drawing benches
9. Pipe bending, welding and coiling
10. Extrusion presses

CLASS 11—Foundry Equipment and Methods

Group
1. Types of Patterns—sweep, one piece, split, skeleton, gated, cores, etc.
2. Molding methods—sectioned models of molds, showing cores, etc.
3. Molding machines—stripping plate, squeezers, roll-over, jolting
4. Molding sands
5. Furnaces, cupola, air furnace, oil crucible, electric, etc.
6. Carrier Foundry
7. Ladles
8. Defects of castings and their causes—Samples
9. Cleaning—Tumbling, Pickling, Sand Blasting, etc.

CLASS 12—Heat Treatment, Hardening, Tempering, etc.

Group
1. Furnaces, coal, gas, oil, electric, etc., for heating and tempering
2. Pyrometers and temperature control, color, scale, etc.
3. Carbonizing, case hardening, etc.
4. Hardening methods, quenching and baths, etc.
5. Examples of heat treatments with photographs showing effects on grain structure, over heating, etc.
6. Method of testing and measuring hardness

CLASS 13—Welding Equipment and Methods, Flame Cutting, Etc.

Groups
1. Types of hammer welds—lap, butt, scarf, etc.
2. Gas—flame, Oxy-acetylene, Oxy-hydrogen, etc.
3. Electric resistance welding
4. Electric arc welding
5. Le Grange—Ho Ho
6. Thermit Welding
7. Soldering
8. Brazing
9. Bronze welding
10. Flame Cutting
11. Chain welding machine

CLASS 14—Wood Working Machines

Group
1. Saws, circular, band, jig, etc.
2. Planers, surfacers and molders
3. Mortisers
4. Lathes
5. Sanders
6. Carving Machines

CLASS 15—Special Classes of Production Machines

Group
1. Machines for Pins
2. Machines for Needles
3. Machines for Balls
4. Machines for Tacks
5. Machines for Watches

Fixtures That Can Be Used in Many Shops

By Frank C. Hudson

Fixtures for both milling machine and shaper that can be adapted to handle a large variety of work in the average shop

WHILE the use of fixtures on shapers is somewhat of a novelty, the Avey Drilling Machine Co., Covington, Ky., employs a number of them in the manufacture of its product. The illustrations and description of the fixtures will give an inkling as to how they can be applied to other classes of work, possibly enabling small shops to put some of their work on a manufacturing basis.

In Fig. 1 is shown the column of a small drilling machine in a box fixture on a shaper. Since the face of the column is to be used for location in future operations, the machining of this surface is one of the first operations to be performed.

The weight of the work being partially taken by the knee support *A* that slides on the base as the work moves across under the cutting tool. The fixture is a combination of castings and steel plates, and is conveniently operated.

Another and smaller fixture for similar work on smaller columns is shown in Fig. 2. The method of holding the casting in the fixture, the jacks at the side *A*, and the table support *B* at the outer end, are all factors that aid in handling the work.

One of the milling fixtures is shown in Figs. 3 and 4, mounted on a No. 5 Cincinnati knee-type machine. As seen in Fig. 3 the table carries two fixtures, each holding a drilling machine column so that both the upper and lower faces of the spindle support can be faced at one setting. The table is fed first in one direction and then the other, milling one column while the other fixture is being loaded or unloaded. A close view of this operation is seen in Fig. 4, which shows the three cutters, *A*, *B* and *C*, that face four surfaces.

Another operation on the same machine is shown in Figs. 5 and 6. Here the large face milling cutter has been replaced by an angular head, to drive the vertical slabbing cutters shown. On the face of the column is a support for the lower end of the cutter arbor.

The columns are the same ones shown in the previous view, turned so as to present the lower ends to be surfaced. As before, the columns are located by the dovetail slide on the front side. The closer view in Fig. 6

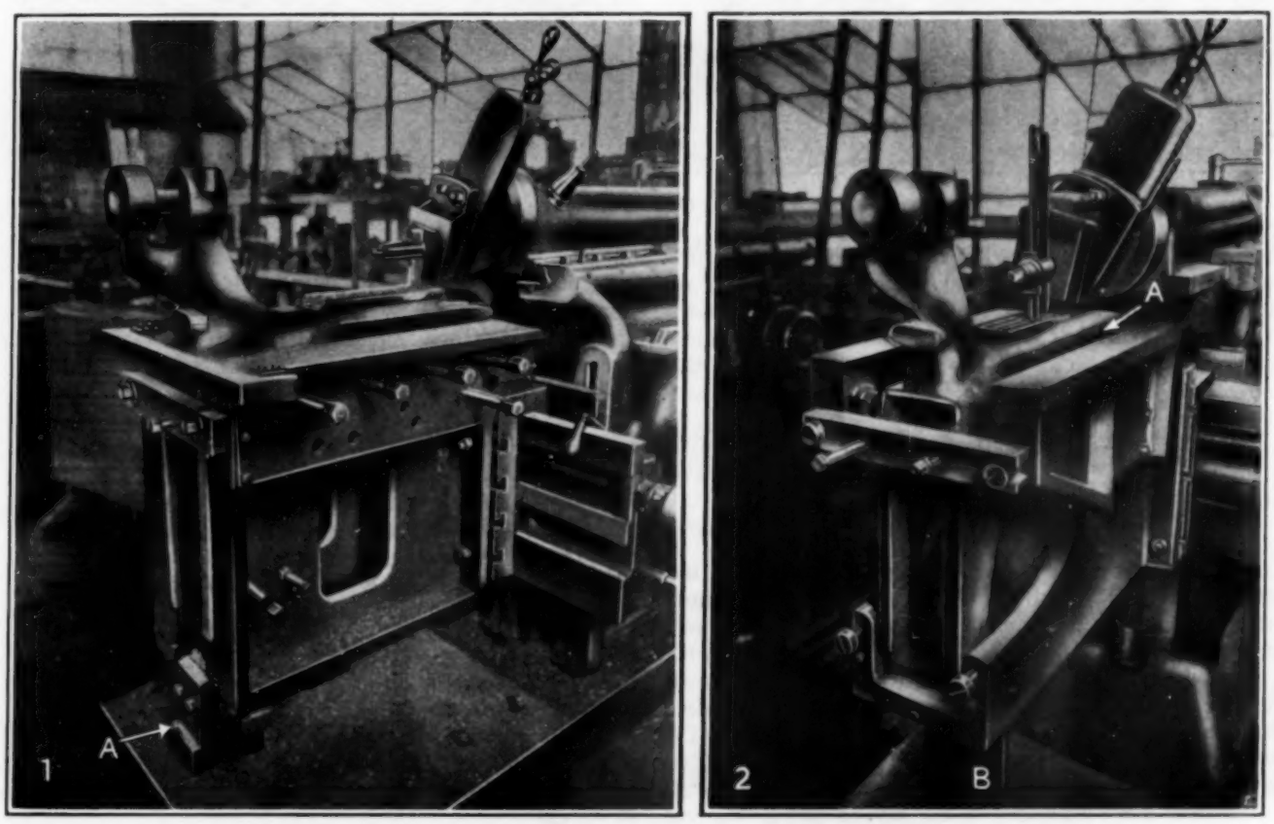


Fig. 1—First operation on column. Fig. 2—Another fixture of same type

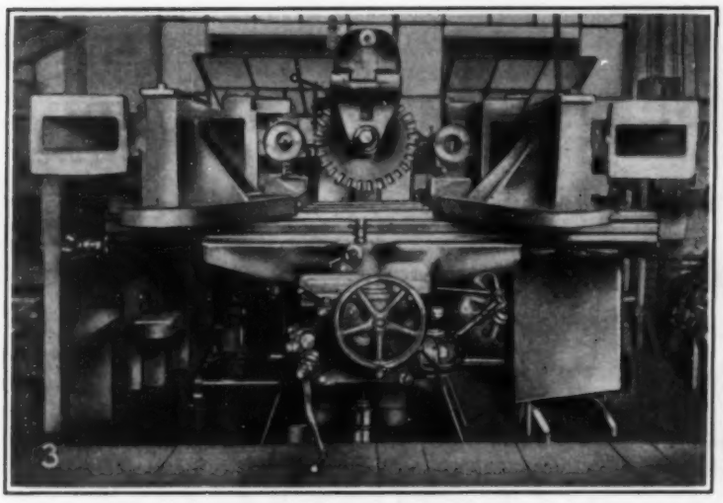


Fig. 3—Milling spindle-ends of support.

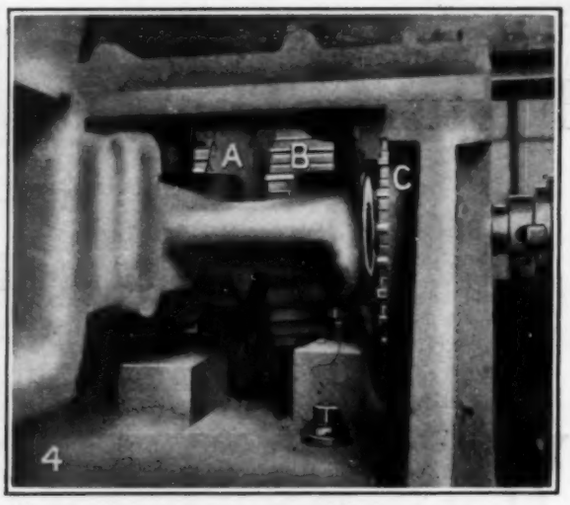


Fig. 4—Close-up of milling operation

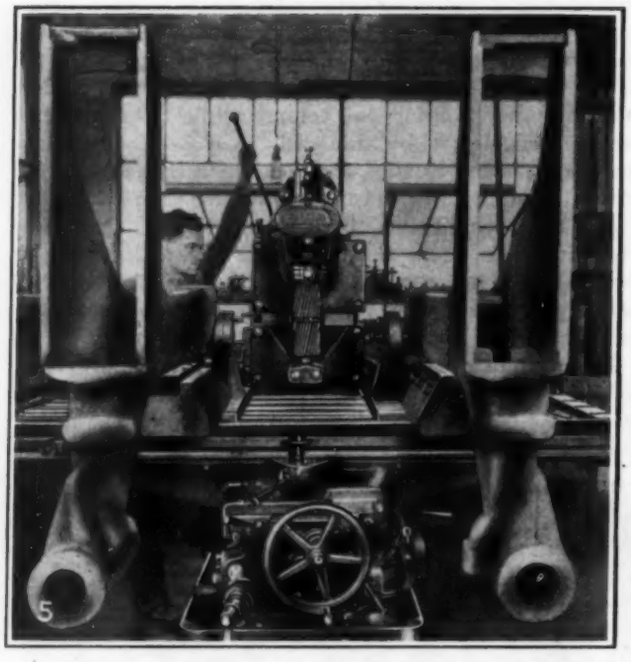


Fig. 5—Another operation on same column.

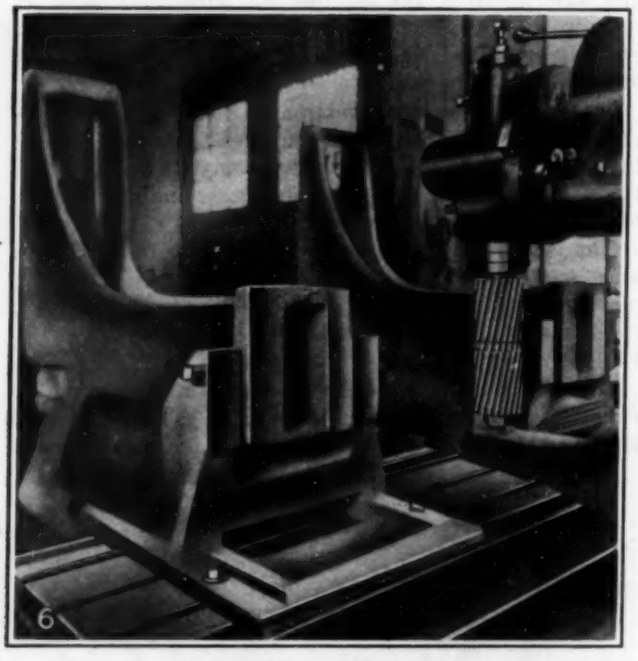


Fig. 6—Details of cutter and fixture

shows the cutter, the driving head above and the support for the lower end. It also gives a good idea of how the work is held and steadied by the side setscrews to take the thrust. It will be noted that the slab milling cutter is formed so as to leave a tongue or key on the end of the column so as to locate it against fore and aft motion, when assembled.

Jim Comes Back

BY ENTROPY

Jim came in again today on that matter of the old men working in his shop. "Say," he said, "you know old man Sawyer. He's one of the men that my efficiency man wants me to fire. Well, he came in yesterday with a scheme for doing some of his work that is going to cut the cost in half. I have been paying 60c. apiece for the labor on those things and I get out upward of a hundred thousand every year. Multiply that by the saving on each and see where I am going to come out.

"Sawyer don't want any of the saving, but he expects me to keep him until he quits for good. Pretty good bargain at that even if he is a tough old codger. Then there's Barney. You remember last Summer he got me out of the hole on that job that I was stuck on. None of the rest of us guessed that we could turn a back pressure valve upside down, but he found out that we could, and that saved me more than it costs to keep him around here for a year."

It does seem like a pretty good case, at that. Only I told Jim that he ought to charge up what he pays these men to inventing, or consulting engineering, or something so that they would be part of the overhead, rather than have the overhead charged against their time. Jim is still puzzling over it.

Jigs and fixtures are now cut and assembled by arc welding. This does away with an expensive pattern which is generally used only once. Many times the completed jig costs less than the pattern itself. And time is also an important item of saving in this line of work.

The Design of Gear Tooth Forms

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

The 20-deg., full-depth tooth gear system gives satisfactory results even with small numbers of teeth—Tooth proportions—Length of contact

THE need of effective gears of smaller numbers of teeth than could be made satisfactorily with the 14½-deg. generated system led to the introduction of other gear tooth systems. Among them was the 20-deg., full-depth tooth system. The tooth proportions of this system are the same as for milled gears, but the pressure angle is increased to 20 deg., which results in smaller base circles and permits gears to be made with fewer teeth without excessive undercutting.

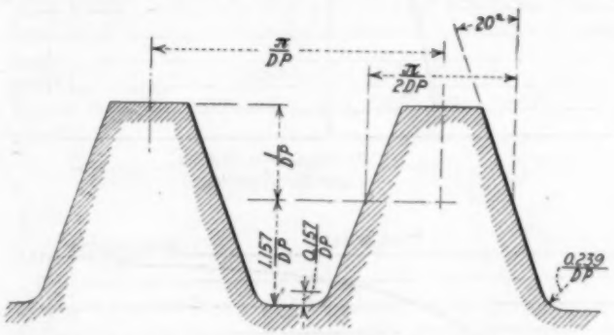


Fig. 51—Basic rack of the 20-deg., full-depth tooth gear system

In addition, due to the wider angle, the tooth forms are stronger than those of the 14½-deg. system. Fig. 51 shows the form of the basic rack of this system.

Analysis of 20-Deg. Full-Depth Tooth System

A similar analysis to that of the 14½-deg. generated gear system will be made of this 20-deg., full-depth tooth system. We will, as before, first examine the 12-tooth pinion of this system.

Let E = outside radius
R = pitch radius
a = radius of base circle
F = addendum of basic rack, including clearance fillet
f = clearance on generating rack or hob
A = minimum root radius without undercut
H = root radius
α = pressure angle
e = excess depth of root beyond undercut limit
x = radial height above base circle of involute profile removed
Q = radius to top of undercut
N = number of teeth
Pn = normal pitch.

The thirteenth article. The fourteenth will appear in an early issue.

We have the following values for a 12-tooth pinion of 1 diametral pitch:

$E = 7.0000$ in.
$R = 6.0000$ in.
$H = 4.8430$ in.
$F = 1.1570$ in.
$f = 0.1570$ in.
$\alpha = 20°$

$a = R \cos \alpha = 5.6381$ in.
Equation (55), eighth article.

$A = R \cos^2 \alpha - f = 5.1411$ in.
Equation (60), eighth article.

$e = A - H = 0.2981$ in.

$x = \dfrac{1.5158 e^2}{R} = 0.0225$ in.
Equation (65), eighth article.

$Q = a + x = 5.6606$ in.

The shape of this pinion tooth is shown in Fig. 52.

We will next examine the contact conditions between this pinion and a rack. We have seen before that the contact between a rack and an undercut gear, in terms of tooth intervals, is equal to

$$\frac{\sqrt{E^2 - a^2} - \sqrt{Q^2 - a^2}}{Pn}$$

In this example, $\sqrt{E^2 - a^2} = 4.1486$
$\sqrt{Q^2 - a^2} = 0.5035$
$Pn = \dfrac{2\pi a}{N} = 2.9521$ in.

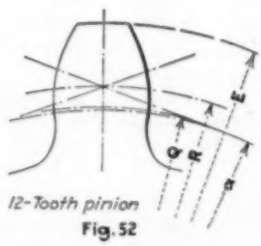


Fig. 52

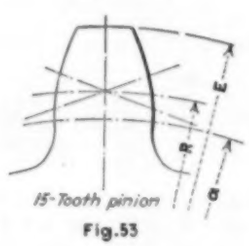


Fig. 53

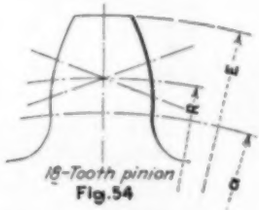


Fig. 54

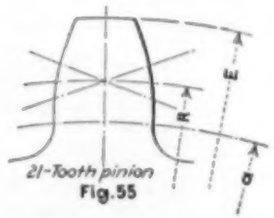


Fig. 55

Figs. 52, 53, 54 and 55—Tooth proportions of 12-, 15-, 18-, and 21-tooth gears, 1 D.P., of the 20-deg., full-depth tooth system

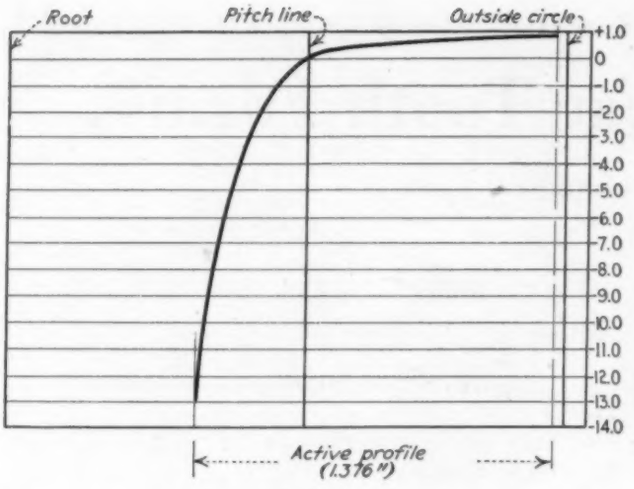


Fig. 56—Specific sliding between two 14-tooth, 20-deg., full-depth tooth gears

Whence contact with rack = 1.234 tooth intervals.

We have also the following equation for determining the contact between two similar undercut gears, when the undercut extends into the active profiles:

$$\text{Contact} = \frac{2\ (R \sin \alpha - \sqrt{Q^2 - a^2})}{Pn}$$

In this example, $R \sin \alpha = 2.0521$ in.

Whence contact = 1.049 tooth intervals.

The contact in both cases is sufficient to give an overlap but hardly sufficient for the quiet transmission of power, for which purpose a contact of 1.40 tooth intervals is desirable, if possible.

The accompanying Table VII gives values of the amount of undercut and contact for 1-D.P. gears of small numbers of teeth, made to the 20-deg., full-depth tooth system.

The forms of 12-, 15-, 18-, and 21-tooth gears made to this system are shown in Figs. 52, 53, 54, and 55.

A second table is given that shows the amount of contact that exists between gears of small tooth numbers made to this 20-deg., full-depth tooth system. The values are expressed in terms of tooth intervals.

It will be seen from this table of contact that two 14-tooth pinions are the smallest pair that give a contact of 1.40 tooth intervals or more. It can also be readily seen that this system is more desirable for gears of small tooth numbers than the 14½-deg. generated gear system.

As before, we will examine other features of the contact conditions. The first table gives data that enable the minimum radius of curvature of the active profile and the specific sliding to be determined readily. As a first example we must examine a pair of 14-tooth pinions. In this case, as before, the minimum radius of curvature of the active profile is at the end of the undercut, and is equal to $\sqrt{Q^2 - a^2}$ which equals 0.3054 in.

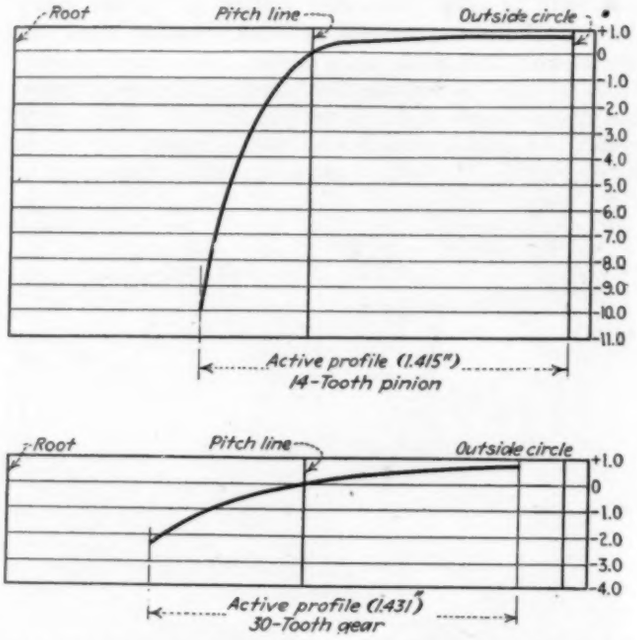


Fig. 57—Specific sliding between a 14-tooth pinion and a 30-tooth gear, 20-deg., full-depth tooth gears

Table VII—Proportions of 20-Deg. Full-Depth Tooth Gear System

Number of Teeth N	Radius of Pitch Circle R	Radius of Base Circle a	Undercut Radius A	Root Radius H	Excess Depth of Cut e	Height of Undercut x	Radius to Top of Undercut Q	Outside Radius E	$\sqrt{E^2 - a^2}$	$\sqrt{Q^2 - a^2}$	$R \sin \alpha$
12	6.00	5.63814	5.14112	4.8430	0.29812	0.02245	5.66059	7.00	4.1486	0.5035	2.0521
13	6.50	6.10799	5.58263	5.3430	0.23963	0.01339	6.12138	7.50	4.3522	0.4045	2.2231
14	7.00	6.57783	6.02414	5.8430	0.18114	0.00710	6.58493	8.00	4.5532	0.3054	2.3941
15	7.50	7.04768	6.46565	6.3430	0.12265	0.00304	7.05072	8.50	4.7518	0.2064	2.5652
16	8.00	7.51752	6.90716	6.8430	0.06416	0.00078	7.51830	9.00	4.9484	0.1074	2.7362
17	8.50	7.98737	7.34867	7.3430	0.00567	0.00001	7.98738	9.50	5.1431	0.0084	2.9072
18	9.00	8.45721	7.79018	7.8430	0.00000	0.00000	.....	10.00	5.3362	.....	3.0782
19	9.50	8.92706	8.23169	8.3430	.....	.....	.....	10.50	5.5278	.....	3.2492
20	10.00	9.39690	8.67320	8.8430	.....	.....	.....	11.00	5.7182	.....	3.4202
21	10.50	9.86675	9.11471	9.3430	.....	.....	.....	11.50	5.9073	.....	3.5912
22	11.00	10.33659	9.55622	9.8430	.....	.....	.....	12.00	6.0954	.....	3.7622
23	11.50	10.80644	9.99773	10.3430	.....	.....	.....	12.50	6.2825	.....	3.9332
24	12.00	11.27628	10.43924	10.8430	.....	.....	.....	13.00	6.4687	.....	4.1042
25	12.50	11.74613	10.88075	11.3430	.....	.....	.....	13.50	6.6541	.....	4.2753
26	13.00	12.21597	11.32226	11.8430	.....	.....	.....	14.00	6.8388	.....	4.4463
27	13.50	12.68582	11.76377	12.3430	.....	.....	.....	14.50	7.0227	.....	4.6173
28	14.00	13.15566	12.20528	12.8430	.....	.....	.....	15.00	7.2061	.....	4.7883
29	14.50	13.62551	12.64679	13.3430	.....	.....	.....	15.50	7.3888	.....	4.9593
30	15.00	14.09535	13.08830	13.8430	.....	.....	.....	16.00	7.5710	.....	5.1303

Table VIII—Length of Contact Between Mating 20-Deg. Full-Depth Tooth Gears in Terms of Tooth Intervals

No. of Gear Teeth	Number of Teeth in Pinion															
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
12	1.049															
13	1.140	1.232														
14	1.232	1.323	1.415													
15	1.234	1.337	1.438	1.481												
16	1.234	1.337	1.438	1.490	1.498											
17	1.234	1.337	1.438	1.497	1.506	1.514										
18	1.234	1.337	1.438	1.505	1.514	1.522	1.529									
19	1.234	1.337	1.438	1.512	1.521	1.529	1.536	1.543								
20	1.234	1.337	1.438	1.519	1.527	1.535	1.542	1.549	1.556							
21	1.234	1.337	1.438	1.525	1.533	1.541	1.548	1.555	1.562	1.569						
22	1.234	1.337	1.438	1.531	1.539	1.547	1.554	1.561	1.568	1.574	1.580					
23	1.234	1.337	1.438	1.536	1.545	1.553	1.560	1.567	1.574	1.580	1.586	1.591				
24	1.234	1.337	1.438	1.539	1.550	1.558	1.565	1.572	1.579	1.585	1.591	1.596	1.601			
25	1.234	1.337	1.438	1.539	1.555	1.563	1.570	1.577	1.584	1.590	1.596	1.601	1.606	1.611		
26	1.234	1.337	1.438	1.539	1.559	1.567	1.574	1.581	1.588	1.594	1.600	1.605	1.610	1.615	1.620	
27	1.234	1.337	1.438	1.539	1.564	1.572	1.579	1.586	1.593	1.599	1.605	1.610	1.615	1.620	1.625	1.629
28	1.234	1.337	1.438	1.539	1.568	1.576	1.583	1.590	1.597	1.603	1.609	1.614	1.619	1.624	1.629	1.633
29	1.234	1.337	1.438	1.539	1.572	1.580	1.587	1.594	1.601	1.607	1.613	1.618	1.623	1.628	1.633	1.637
30	1.234	1.337	1.438	1.539	1.576	1.584	1.591	1.598	1.605	1.611	1.617	1.622	1.627	1.632	1.637	1.641
Rack	1.234	1.337	1.438	1.539	1.639	1.739	1.755	1.762	1.768	1.774	1.780	1.786	1.791	1.796	1.800	1.805

We will also determine the specific sliding conditions. We have from equations (23) and (24) in the sixth article:

$$\text{Specific sliding on pinion} = \frac{b_1N_2 - b_2N_1}{b_1N_2}$$

$$\text{Specific sliding on gear} = \frac{b_2N_1 - b_1N_2}{b_2N_1}$$

Where b_1 = radius of curvature of any point on pinion tooth profile

b_2 = radius of curvature of mating point on gear tooth

N_1 = number of teeth in pinion

N_2 = number of teeth in gear.

At the beginning of contact, b_1 is equal to the minimum radius of curvature of the active profile, which equals 0.3054 in.; b_2 is equal to the total length of the line of action minus b_1. In this example, the total length of the line of action is equal to $2R \sin \alpha$, which equals 4.7882 in. Whence b_2 equals 4.4828 in.; N_1 and N_2 are both equal to 14 and cancel from the equation. Thus we have

$$\text{Specific sliding at beginning of contact} = \frac{0.3054 - 4.4828}{0.3054} = -13.67$$

The values of b_1 and b_2 are reversed at the ending of contact, whence we have

$$\text{Specific sliding at ending of contact} = \frac{4.4828 - 0.3054}{4.4828} = +0.93$$

This specific sliding is plotted in Fig. 56.

We will also determine the specific sliding conditions on this same 14-tooth pinion when it meshes with a 30-tooth gear. The minimum radius of curvature of the active profile of this pinion is the same as before. The total length of the line of action is equal to the sum of the respective $R \sin \alpha$'s for each gear; this is equal to 7.5244 in. Whence we have for the sliding conditions at the beginning of contact

$b_1 = 0.3054$ in.
$N_1 = 14$ teeth
$b_2 = 7.2190$ in.
$N_2 = 30$ teeth.

$$\text{Specific sliding on pinion} = \frac{0.3054 \times 30 - 7.2190 \times 14}{0.3054 \times 30} = -10.03$$

$$\text{Specific sliding on gear} = \frac{7.2190 \times 14 - 0.3054 \times 30}{7.2190 \times 14} = +0.91$$

In this example, the active profile of the pinion extends to the tip of the tooth, so that at the ending of

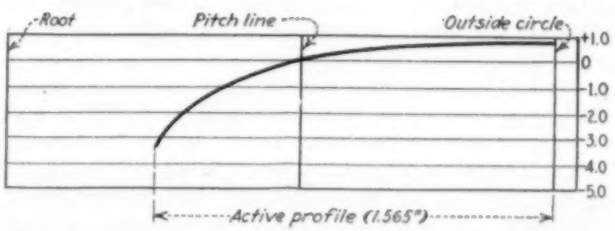


Fig. 58—Specific sliding between two 20-tooth, 20-deg., full-depth tooth gears

contact, the radius of curvature on the pinion is equal to $\sqrt{E^2 - a^2}$, which equals 4.5532 in. Thus we have for the sliding conditions at the ending of contact

$b_1 = 4.5532$ in.
$N_1 = 14$ teeth
$b_2 = 2.9712$ in.
$N_2 = 30$ teeth

$$\text{Specific sliding on pinion} = \frac{4.5532 \times 30 - 2.9712 \times 14}{4.5532 \times 30} = +0.69$$

$$\text{Specific sliding on gear} = \frac{2.9712 \times 14 - 4.5532 \times 30}{2.9712 \times 14} = -2.28$$

This specific sliding is plotted in Fig. 57.

A comparison of these charts with those shown in Fig. 50, twelfth article, shows that the contact in these smaller gears has been secured at the expense of more sensitive tooth profiles. This is inevitable with small tooth numbers. In order to secure greater contact, more sensitive, and troublesome, tooth profiles must be employed. It is possible, however, to minimize these troublesome conditions by suitable tooth design. This subject will be considered further in a succeeding article.

In order to make a direct comparison with 14½-deg. generated gears, we will examine the sliding conditions on a pair of 22-tooth, 20-deg., full-depth tooth gears. Here, the contact extends to the tip of the tooth, so that the maximum radius of curvature of the active profile is equal to $\sqrt{E^2 - a^2}$, which equals 6.0954 in. The minimum radius of curvature is equal to the total length of the line of action minus the maximum radius of curvature. The total length of the line of action is equal to $2R \sin \alpha$, which equals 7.5244 in., whence the minimum radius of curvature of the active profile is equal to 1.4290 in. Thus we have the sliding conditions at the beginning of contact

$$\text{Specific sliding} = \frac{1.4290 - 6.0954}{1.4290} = -3.26$$

The values of b_1 and b_2 are reversed at the end of contact, whence we have

$$\text{Specific sliding} = \frac{6.0954 - 1.4290}{6.0954} = +0.76$$

This specific sliding is plotted in Fig. 58. A comparison of this chart with that shown in Fig. 49 (twelfth article) shows more favorable conditions for the 20-deg. full-depth tooth.

Rewarding Employees for Acceptable Suggestions

By Oliver Franklin

SUGGESTION boxes are a common sight in most large plants, but a great many of them are covered with dust and have rusty locks. The trouble seems to be due to a lack of interest on the part of the employees for several reasons: the rewards are too small, action is delayed too long, or there is too little publicity and too little follow-up work being done. At the Stromberg-Carlson Telephone Manufacturing Co., Rochester, N. Y., however, there is a real suggestion system that is sound in principle and should be self-perpetuating as far as interest goes. The idea applies to improvements in operation routine. There the Bedaux system of payment is used, but the scheme of rewarding employees for valuable suggestions could as well be adopted to any system of piecework payment.

When a new part is to be manufactured, the operation routine is planned and time-studied in the usual way, and when the final routine has been selected and the standard time set for each operation, a permanent record is made on an operation analysis sheet. Besides giving a brief, but complete, description of each operation and the standard time, the analysis sheet also describes the tool and machine used in each case, as well as the speed of operation of the latter. Once set, the standard time on a particular piece is not reduced unless there is a change in the operations. The operators are encouraged to make suggestions for improvements in the operation routine by being offered a liberal reward. On the other hand, if an operator makes a change in the routine without informing the management, he receives no reward if later the changed routine is adopted. It is believed that the reward is sufficient to offset this temptation.

Suggestions are made on blank forms, which are placed beside each departmental bulletin board. The form and the envelope for containing it are addressed to the general manager, who first reviews the suggestion and detaches a perforated strip that identifies the employee submitting the suggestion. He then passes the suggestion on to the suggestion committee consisting of the general superintendent, the assistant-chief engineer, the master mechanic, and the chief of the process improvement department. The committee meets every fortnight.

Scale of Rewards

If an employee, other than a foreman or sub-foreman, makes a suggestion that is accepted, he is rewarded with a sum of money that represents the estimated net saving for six months that will result from the use of the improved process. A sub-foreman is rewarded with the net saving for three months, and a foreman with the net saving for two months. It is felt that foremen and sub-foremen are not entitled to as large a reward as other employees because improvements in methods are a regular part of their job for which they are paid higher rates. On the other hand, in order that foremen and sub-foremen will encourage the employees in their departments to send in suggestions, an additional reward is paid monthly to the foremen and sub-foremen directly in charge. It is equal to ten per cent of the amount paid to employees in their department for accepted suggestions during the preceding month.

The estimate of the quantity of goods to be produced in the next two, three, or six months is based on past usage. The net saving includes saving in both material and labor. Payment is made within two weeks of the time that the new process has been definitely determined and a new standard set. The payment is made in full. No deduction is made for changes in tools and equipment, unless their cost is excessive.

In those cases where the production of a piece is large and the time saved by the improvement is tangible, it is not unusual to find that the reward runs into several hundred dollars. The company benefits from the savings made on the other operators doing the same work. It is believed that this system of reward is one of the factors that is responsible for the low labor turnover that this plant enjoys. Over one thousand persons of both sexes are employed and the average number of points on the Bedaux system is 80 B's, a statement that, on a par of 60, means that the average employee makes his base rate (which is high for this locality) plus a premium that is 25 per cent of his total pay.

The nearer we can approach steady employment the greater co-operation we can get in the shop. It's something like a man renting a house by the month for an uncertain period. He doesn't feel as much like fixing up the yard and planting posies as though he had a year's lease. When a man feels that he really "belongs" to an organization, he can be depended on to give more and better service than on a temporary job.

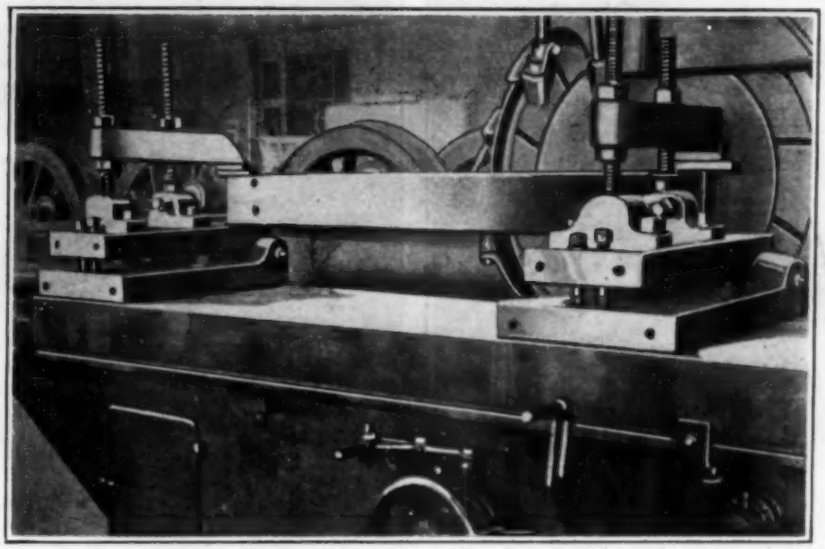


Fig. 1—Surface grinding a crosshead guide

Air Tools Prominent at K.C.S. Shops

By Frank W. Curtis
Western Editor, *American Machinist*

Universal grinding fixture for guides—Planing driving boxes—Machining shoes and wedges—A variety of unusual air-operated tools for miscellaneous work

MANY new machines have been added recently to the equipment of the shops of the Kansas City Southern Railway Co., at Pittsburg, Kan., to handle locomotive repairs and miscellaneous work. Although the mileage operated by the company is not as great as that of some of the mid-western railroads, the shops are an example of an up-to-date plant for the maintenance of motive power.

The back shop is of modern construction, well-lighted and ventilated, 604 ft. in length and 150 ft. in width. Sixteen working pits are located at the north side of the shop, six of which are of special design to accommodate engines of the Mallet type. The remainder of the lower floor is used for the machine, forge and boiler shops. A balcony on the south side that extends the length of the machine and boiler shops is used for the

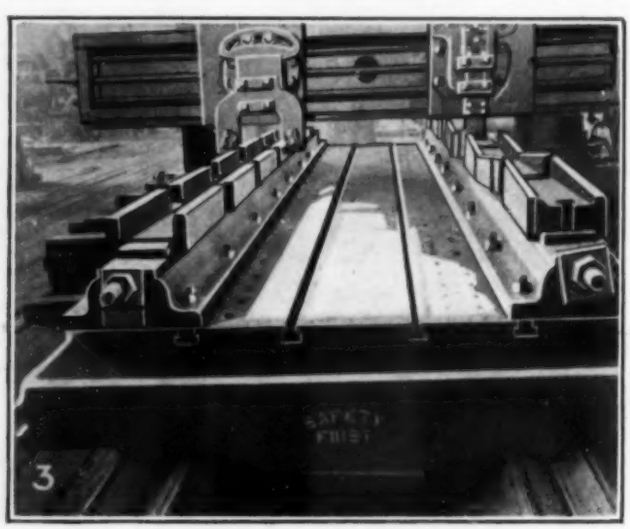
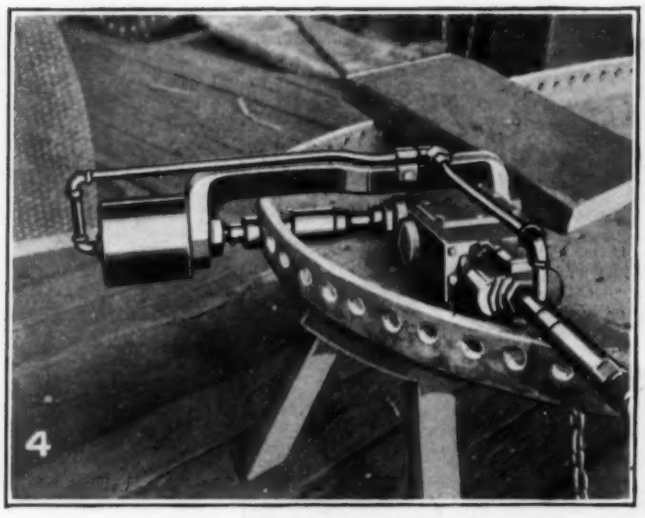


Fig. 2—Planing shoe and wedge faces of driving boxes. Fig. 3—Set-up for planing shoes and wedges



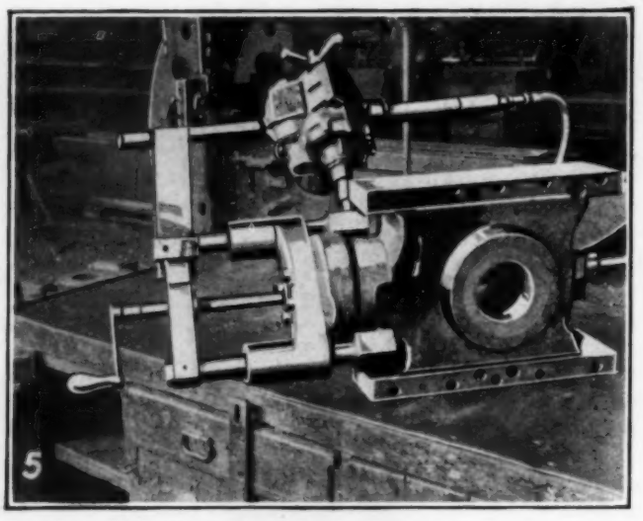


Fig. 4—Countersinking flanges of flue sheets. Fig. 5—Cutting key slot in a crosshead

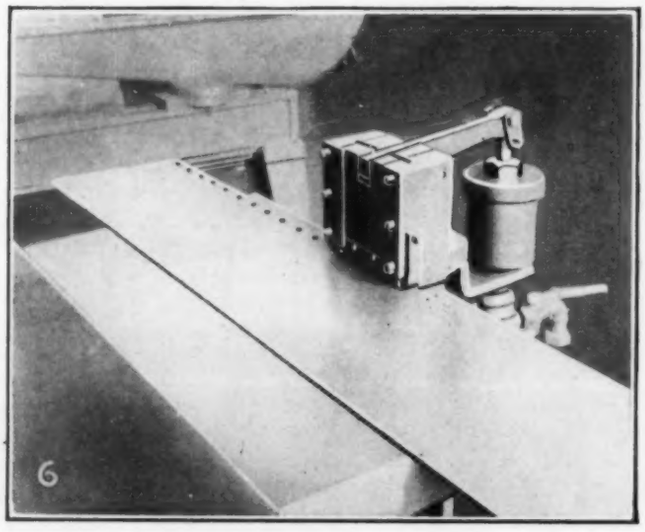
toolroom, tin shop, pattern work, pipe work, air brake and injector repairs, and locomotive-headlight work.

One of the policies of the company is to turn out first-class work at all times on all jobs. To accomplish this task efficiently, the need of modern equipment was visualized, so an effort has been made to install equipment that would comply with the desired requirements. The result is that the greater number of the machine tools seen in the shop are of modern design, well maintained and so placed as to facilitate handling the work. The improvement has reduced the cost of many repairs, so that in spite of the fact that all the machines are not kept in constant operation, the initial investment is paying dividends.

Crosshead guides are surface ground on a Diamond grinder as shown in Fig. 1. The work is held in a universal fixture that can be adjusted to accommodate all sizes of guides. The fixture is comprised of two units of similar design that are fastened to the machine table at a correct distance from one another to suit the length of the work. The guide is located on the front side of the sub-bases of the fixture, after which the clamps are adjusted to hold the work securely. The clamps are self-contained on the sub-bases and are arranged to suit the height of the work by raising or lowering the check nuts on the two vertical screws. The sub-bases are pivoted on pins, located in the front portion of the base, so that by adjusting the setscrews and locking screws, shown at the rear ends, the work may be presented to the wheel at a proper angle.

The abrasive wheel is 36 in. in diameter and consists of twelve segments having 6 in. of grinding surface projecting beyond the chuck. The machine is also used for grinding false-valve seats, slide valves and other flat-surfaced work, in most cases utilizing the fixture illustrated.

Driving boxes are handled in quantity lots, whenever possible, to insure uniform sizes and to reduce handling time. The shoe and wedge faces of driving boxes are machined on the Niles-Bement-Pond planer as shown in Fig. 2. The fixture, mounted on the machine table, holds six units that are located by their bottom faces on locating pads. End blocks, built in the fixture base, locate the work endwise and take the pressure of the cut. Each driving box is held in place by a heavy strap clamp as shown. The heads of the machine are equipped with special toolholders that replace the regular tool slides. This feature is necessary to provide ample clearance when the toolholders are lowered below the top face of the work. Both sides of the driving



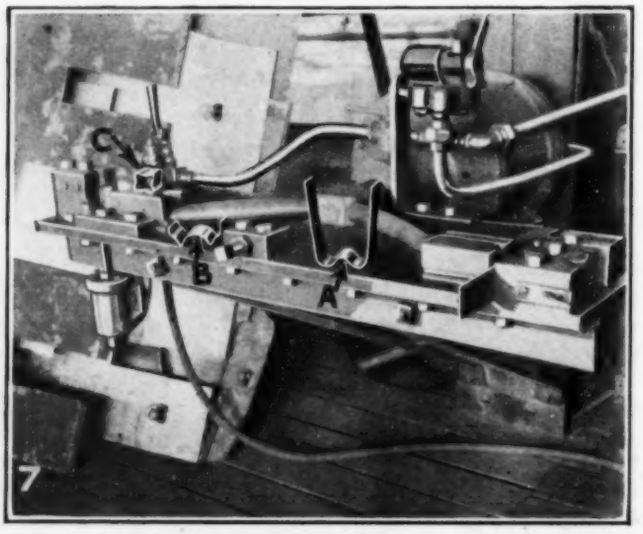


Fig. 6—Method of punching jackets. Fig. 7—Forming superheater flue parts

boxes are machined simultaneously, two tools being used.

Seven shoes and eight wedges are planed at the same time by means of fixtures attached to the Gray planer shown in Fig. 3. The work rests on the top of the fixture and is located from the flat sides. Between each unit is mounted a floating hold-down clamp and at the front end of the fixture is a stop plate for end location of the work. Sliding clamps, located at the rear end of the fixture, are drawn against the work by the nuts, shown at the front end, which are connected to draw bars that run the full length of the fixtures. The floating hold-downs, held in place by the draw bar, are made with angular-serrated faces that draw the work tightly against the fixture as end pressure is applied.

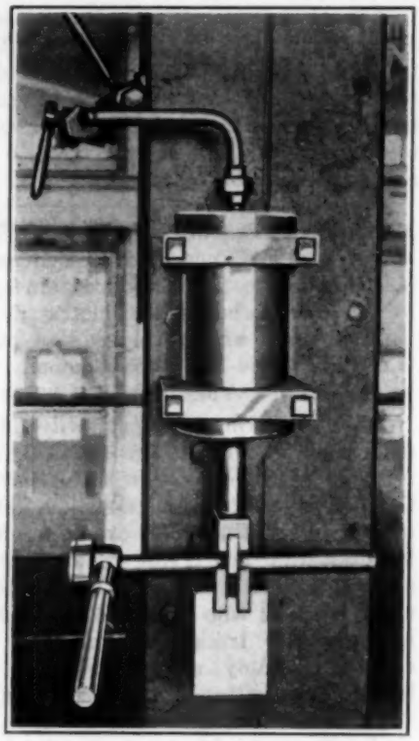


Fig. 8—Air-operated pipe vise

The illustration shows the shoes on the left-hand side being machined on the outer sides by a straddle tool attached to the tool-slide. The toolholder is U-shaped to clear the work. The work overhangs the fixture sufficiently so the cutting tools can pass the faces of the work. The wedges at the right are machined at the same time on the inside surfaces by the tool shown in place. When these respective surfaces are completed, the tool-holders are changed so the inner side faces of the shoes and the outer side faces of the wedges can be machined. The bottom faces of the work are planed with tools of the usual type.

A number of air-operated tools that are home-made may be seen in operation throughout the shop. Among them is the flue-sheet countersinking device shown in Fig. 4. The tool is used to countersink the inside face of flange holes. An overhanging bracket, fastened on the air motor, is provided with an air cylinder piped to the intake of the air motor as shown. When the tool is put in place and air pressure applied, the plunger attached to the cylinder bears against the outside surface of the flange, causing a drawing action between it and the air motor, through the connecting bracket. The result is that the countersinking tool cuts into the work until the sleeve, that is mounted on the tool, strikes the inner face of the flange. This sleeve is adjustable to provide for the depth of countersink required. The device has considerably reduced the time formerly required to accomplish this operation, when it was necessary to use an "old man" for backing-up purposes.

The air-operated device shown in position in Fig. 5, is used for cutting key slots in crossheads. A guide plate having a tapered plug, corresponding to the taper of the piston rod, is placed in the crosshead as shown. Two sliding bars are assembled to the guide plate and connected at the outer ends with a strap that has a nut fastened centrally to it. The ends of the sliding bars are provided with hardened bushings that act as bearings and supports for the $\frac{1}{4}$-in. helical cutter that is located between them, and which passes through a $\frac{1}{4}$-in. drilled hole in the crosshead. A lead screw passes through the plug to the rear end of the work and is held in place by a plate backed up by a nut. The lead screw is prevented from end movement by a collar. An air motor is attached to the cutter after the device has been properly adjusted. By turning the lead screw with the handle at the outer end, the sliding bars are drawn inward causing the cutter that is carried with them to machine the key slot. The air motor is prevented from turning by a stop plate fastened to the sliding bars, as illustrated. The operation, including the drilling of the hole, is completed in 45 minutes.

The air-operated punch shown in Fig. 6, is used for piercing jackets. Three holes are pierced at once with this device. The section of the jacket to be punched is brought in line with the far edge of the punch. The air valve then is operated causing the arm, attached to the air cylinder, to lower the ram of the press, thereby punching the first set of holes. A stripper plate is provided, in the event the work should have a tendency to bind on the punches. The jacket section then is moved along the table until the third hole that has been punched engages with a pin located on the work table. The operation is continued until the entire side has been pierced. The advantages of this device are that the holes produced are equally spaced, and the work is handled in less time than was required by the old method that punched one hole at a time in accordance with layout marks.

Another air-operated device of unusual design is the machine for forming superheater parts, as illustrated in Fig. 7. An air-operated cylinder is used to operate a knuckle joint attached to slides on each end of the table. The slides are provided with forming punches that work in connection with dies attached to the table. A flat piece of metal is placed between the punch and die as shown at the right-hand end. When air pressure is applied, the work is formed to the shape shown at *A*. At the left-hand side at *B* is shown a flue spacer that is

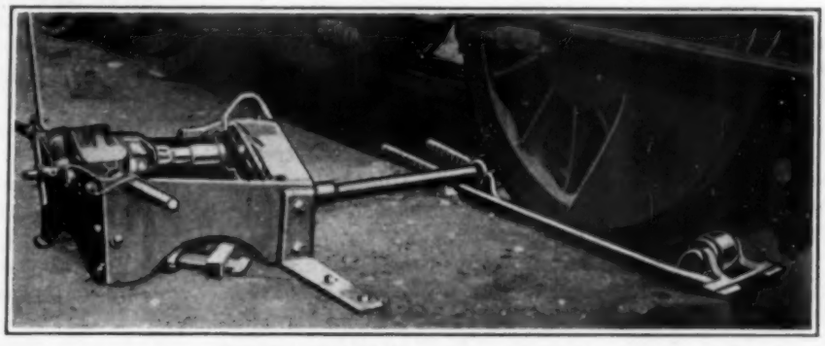


Fig. 9—Device for setting valves

finished to the form *C* by applying corresponding inserts in the forming portions of the punch and die. Under the table at this end is fastened a small air cylinder provided with an ejector to remove the work after it has been formed over the center plug.

The pipe shop is equipped with air-operated vises, one of which is shown in Fig. 8. The device is attached to an I-beam of the building by strap clamps, or to walls by other suitable means. The air cylinder has the usual form of pipe jaw fastened to the ram while directly under it, and in line with its center, is located an anvil with corresponding jaws. The vise is used to hold pipe for threading, cutting off, and for miscellaneous operations.

Valve timing of locomotives is greatly simplified by the air-operated, wheel-turning device shown in Fig. 9. The unit is portable so it can be operated at the various pits. An air motor is housed by a frame that has a reduction gear at the front end. The output power is delivered to a shaft, extending across the pit that has two driving rollers attached to it that line up with the driving wheels. The engine is jacked up so the idler roll, shown to the right-hand side, can be drawn towards the driving roll by means of the connecting screw. The opposite side has a similar connection. The weight of the engine then is placed on all the rollers so that when the air motor revolves in either direction, the driving rolls, through friction, cause the driving wheels to revolve accordingly.

Book Reviews

Industrial Furnaces. By W. Trinks, Professor of Mechanical Engineering at Carnegie Institute of Technology. Second Edition, Vol. I. Three hundred fifty-two pages, 6x9 in., cloth boards, two hundred eighty-three illustrations and diagrams. Indexed. Published by John Wiley & Sons, Inc., New York. Price $4.50.

Heat-treating has become such an important part of general shop practice that this revised work should be useful in any mechanical library. The author has divided the book into six chapters, taking up in the first the various types of furnaces, and then following in a thorough manner the subjects of heating capacity, fuel economy, heat-saving appliances, and the strength and durability of furnaces. In a lengthy appendix he also takes up the mathematical relations of temperature in furnaces, and fuel consumption.

Attention is given to the proper construction of furnaces to obtain the highest efficiency for various heat-treating purposes. The book is subject paragraphed for textbook or reference use. The illustrations are line drawings, and show clearly the mechanical features of the furnaces discussed.

Trade-Mark Profits and Production. By Harry A. Toulmin, Jr. Two hundred fifty-eight pages, 6x9 in., cloth boards. Illustrated. Indexed. Published by the D. Van Nostrand Co., New York. Price $4.

This book is intended to fill the need for a non-technical outline of the whole subject of trademarks. Its four chapters cover the conditions, selection, protection, and general use of trademarks, with copious live examples drawn from actual trade. The text is subject-paragraphed for easy reading, and explanations are aided by graphic illustrations.

The appendix contains the United States trademark law, the Pan-American Convention regulations, and the trademark laws of the various states that have separate regulations on this subject. The volume is one that should prove valuable to sales and advertising managers, or to manufacturers who intend to select a trademark or extend the use of their present mark to foreign countries. It is a complete treatise on the value and applications of trademarks.

Methods of Teaching Industrial Subjects. By Dr. Arthur F. Payne, of the Teachers College, Columbia University. Two hundred ninety-three pages, 6x9 in., cloth boards. Illustrated with half tones, drawings, and tables. Cross indexed. Published by McGraw-Hill Book Company, Inc., 370 Seventh Ave., New York. Price $3.

This book is intended primarily for the use of skilled tradesmen who have been called to teaching in industrial or trade schools without having had previous training in teaching methods. A difficulty with many industrial schools is that expert mechanics trained only in production are trying to practice teaching without such vocational training. The author points out that trade workers who aspire to be teachers must learn to analyze their trades, and classify the material into courses of study, as well as to be able to judge the learning capacities of their students.

The eighteen chapters of the book are well arranged to develop the subject. A sketch of the history of industrial teaching is given, and the influence of early teachers in the development of methods. State and Federal regulations are analyzed, and a chapter is devoted to an explanation of the terminology of the subject.

The principles of teaching, and the laws of learning, are explained in a simple manner. Methods used in schools of the country are shown, with practical illustrations of job sheets and layouts for the presentation of subjects. Although intended chiefly for teachers, any foreman or executive will find valuable every-day material in the book, especially in the chapters on the technique of job analysis, and on the study of youths at different ages.

Wörterbuch der modernen Maschinenwerkstatt. Illustrated Dictionary of Shop Terms, Machine Tools, Implements, and Methods of Production. Part I, English-German. By H. O. Herzog. Three hundred twenty-six pages, 5x7½ in. Cloth boards. With 227 cuts in the text, and 18 plates. Published by Guido Hackebeil, A.G., Berlin S 14, Germany. Price 15 marks.

A compact and handy English-German mechanical dictionary that should be valuable for making translations into German of trade letters or articles, or for anyone having to deal with the German machinery industry. Its many illustrations are an assurance against the choice of the wrong word so common in making translations. The full page cuts show common types of metal working machines with designation of the German names of parts.

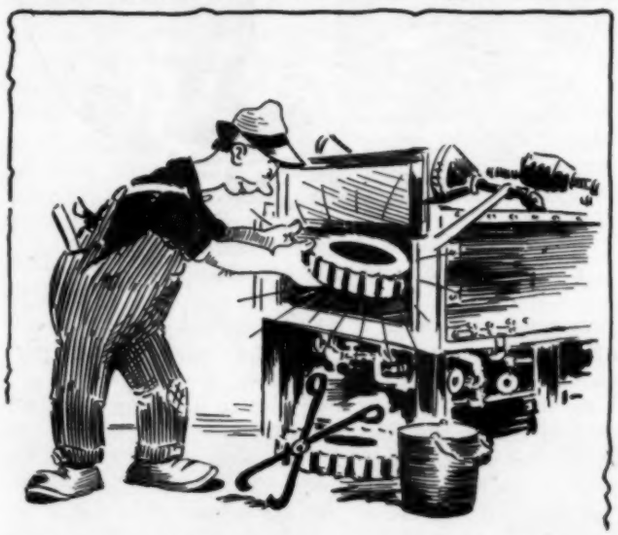
John Dick's Compound

By F. M. A'Hearn

John's "Horse Sense" solves management problems —The workmen have a right to know—Mutual honesty in relations keeps the compound right

IT WAS the morning after. Not "the morning after the night before," as used in the terms of a once popular song, but the morning after John Dick's birthday. This birthday, by the way, had come to be an annual gala day for three men: John Dick, guiding spirit of the Dick Pump Works, Jim Kelly, the well-known machine tool man, and Bill Weston, Master Mechanic of the Coaltown & Great Western Railroad.

Mrs. John Dick had, some years ago, decreed that the three apprentices who had worked side by side under old John Dick, father of the present John, should meet each year on the anniversary of John's birth. To gather in John's comfortable home, within sight of the old



"Bill can be trusted to charge heats. Why not trust him with other information?"

Dick Pump Works, now greatly enlarged, always brought happy memories to the trio, and it had come to pass that Kelly and Weston were spending in Woodland the day following John's birthday. As this day was a holiday, the three had ample chance to prowl to their heart's content about the premises where they once worked together. Anyone who has enjoyed the autumn sunshine of Western Pennsylvania will vision the get-to-gether meeting of the three, held on a pile of flask lumber in the yard of the Pump Works.

"John," said Kelly, "You always seem to have peace and quiet at the Pump Works. Your plant has grown and prospered, your men are contented and are property owners and substantial citizens of Woodland; you, yourself, are looked up to as one of the shining lights of the community. When you are a candidate for a public office it appears that the majority of the population are solid for you. Now, just among three old friends, what is the secret?"

"Boys," said John, "The principal secret in the management of the Pump Works is that we have no secrets. True, we don't broadcast our affairs to the public; that is not necessary, they are not interested. However, I like to have every employee of my plant feel that they are directly responsible for the success of the business as a whole. Therefore, they must know our objectives."

"Just like a big family," volunteered Bill.

"No, Bill, not exactly like a big family. That is a pretty phrase, but it does not carry any weight. I don't like it anyhow. I would rather quote Ben Franklin in saying that 'We must all hang together or hang separately.' In other words, we wish to have everyone connected with the business understand that the job and wages of the worker, as well as the return on the capital investment, depend entirely on the combined efforts of those who make up the personnel of the Dick Pump Works. We don't want men continually on edge wondering whether they will have work for the next year or whether we will go on short time day after tomorrow. That state of mind would deter them from buying homes and would tend to make floaters of them.

"We don't care to have anyone assume an air of importance and confide a hint to the fellow on the next bench that something is going to happen the first of next month. We don't care to have our shipping clerk feel that he is custodian of a secret that we would not trust with old Bill Jackson, the cupola tender. A timely suggestion from Bill Jackson will sometimes mean as big a return to the concern as will some pet scheme of my own. Bill has been here a long time. If I can trust Bill to charge heats properly, why should I not trust him with the information that I have taken a certain contract at a close margin in order to keep the wheels turning? I know that Bill will appreciate the situation and do his bit to put the job through at a minimum cost."

"John," said Kelly, "You are truly a chip of the old block. I have occasion to remember your father telling me one day in 1894 of a certain contract he had just finished. The tone of his remarks was as yours has been. This was before the days when the works possessed the yard crane and the railway siding over yonder. We had hauled and loaded the last of the castings during an April shower. The fact that I was a machinist apprentice did not deter John, Sr., from appointing me assistant to Al McMichael, the drayman. Incidentally, I had helped pour the heat and had cleaned some of the castings. I came back to the shop soaking wet and not over cheerful. Your father cau-

tioned me to dry my clothes and not take cold. Possibly my expression prompted him to tell me something that made a lasting impression.

"'Jim,' he said, 'it's pretty rough on you to put in your time chipping castings and laboring at odd jobs as you are doing. However, your pay is going on every day, that's something. Now, that job you just finished loading; I took that contract at a bottom figure, scrap is cheap and open sand plates are easily made. The result is that all you boys have had employment, and I have had you here to take any other job that offered a chance to turn an honest penny.'

"His remarks caused me to understand that my own co-operation was needed. That I earned my daily wage was of course implied, but back of that was the thought that I must help to keep the businses giong during a dull period. That I absorbed the lesson may be established by the fact that a few days later I bored more mine car wheels in a ten-hour day than had ever before been turned out in the shop. Ever since, I have had a better understanding of the relations of owners and employees."

"Your day's work of car wheels remained a record, Jim," said John. "Father often spoke of it. That was one of the reasons, not secrets, of his success. He would give credit where credit was due, and never hesitated to show his appreciation of work well done. In the later years of father's life, as he began to turn over certain details of the business to me, he sometimes hauled me up short when I was inclined to act too hastily. 'Horse sense,' he would say, 'Use horse sense, John.'

The Prescription

"As years passed I have learned the value of his advice, and have worked out an imaginary compound, a sort of tonic for shop troubles. Something like this: Take horse sense for a basis just as the druggist uses a syrup to disolve a few tablets or powders when he fills a prescription. Horse sense may be used in any situation as it does no harm and is always beneficial. The other ingredients are knowledge of human nature, confidence, honesty, and firmness. The foregoing items mixed in varying amounts to suit individual cases form a mighty useful compound to keep in the executive desk. Horse sense, together with knowledge of human nature and confidence, forms a wonderful lubricant when a unit in your organization begins to heat. Very often a light application puts things right. Fact is, Jim, that was the mixture that father used the day you came in cold and wet. Your own statement of your quick reaction to the treatment is sufficient proof of its value.

"Honesty is very useful in keeping the compound in good condition at all times; sort of a preservative, you might say. We like to have it used liberally; pays too; brings out a spirit of good workmanship. When a man puts a little of it on a job he is doing it makes defective work look unsatisfactory to him. We show, by using it in our compound, that we would rather have men admit that they have made an error than to have them cover up defects that will later be discovered by our customers. When we see that a man feels hurt over a mistake which he has made and acknowledged, we don't pat him on the back for his error, but we make him understand that the matter would be far more serious had he attempted concealment.

"At the same time we of the management try to learn if our instructions or methods are reasonably error proof. If we find that we have contributed to bringing about the mistake we get busy and do our part to avoid a repetition, and we don't crawfish over it either. We know that when, through our fault, a job we have put out goes wrong, the job or machine cannot express regrets or make explanations to the irritated customer. Sometimes he is at fault by rough usage, but the machine cannot defend itself. We, therefore, try to do all work honestly. Financially as well as normally it is the best policy.

"Firmness is good to use in honing down a rough spot that galls the surface it come in contact with. The tendency to cut too rapidly makes the use of firmness in the raw state unadvisable. Properly mixed with the horse sense compound, it may be applied as a strong solution, and will work out the rough spots without permanently marring a good surface. You know that's a thing that must be watched. Get to handling the stuff carelessly and you may either get a low spot in the bearing or score it so badly as to take a lot of trouble to get things in shape again. The low spots indicate that lessened interest exists; the scores show up in increased labor turnover. I try to be very careful and use just enough, and not a grain more.

"We hauled the last of the castings during an April shower."

"You men know that nowadays we have our lubrication engineers, our efficiency engineers, and many other specialists that can do for a dollar something that anybody can do for five. Same with our compound. Costs little to prepare, but has a special purpose and performs wonders for a small outlay. Possibly it costs an executive a small piece of his dignity to admit that he is wrong or has been hasty, but dignity is a cheap commodity that does not add a nickel to the value of a ton of castings. Therefore, our compound does not cost much in dollars and cents. A little 'horse sense,' Bill, that's all."

This is the time of year to consider improvements in your shop lighting for next fall and winter. By planning ahead you can decide on the improvements and be all ready to install the system before it is actually needed.

Automotive Production

Fixtures for Overhead-Camshaft Bearings

By Fred H. Colvin
Editor, *American Machinist*

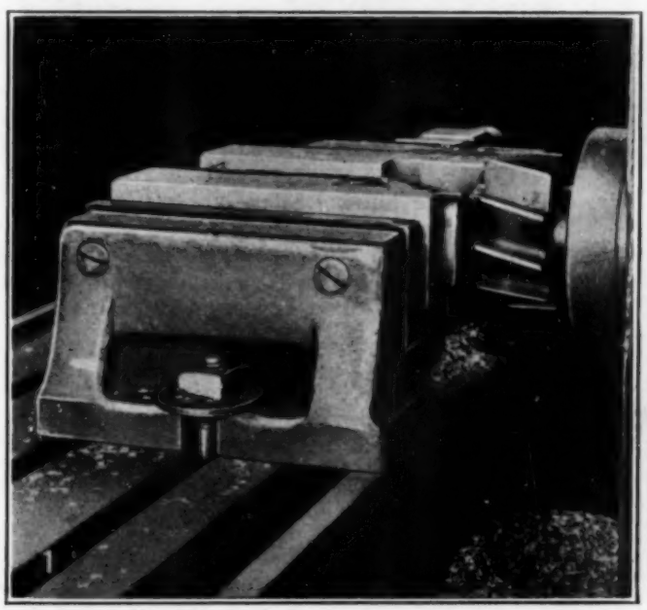
A bronze, self contained bearing, that requires careful work and is made in special fixtures —Bearing surface is ground automatically

THE camshaft of the new Stutz engine is of the overhead type, so that instead of the shaft bearing being in the cylinder block or crankcase, separate bearings are provided on top of the cylinder head. These bearings are of bronze, with feet that are bolted to the cylinder head and with caps that form the tops. There are five bearings, and although only one of the center bearings is shown, they are so nearly alike as to make this one typical of all. The thrust of the camshaft is taken on the front bearing which is finished on both sides with a tolerance of 0.001 in. The other four bearings are not finished on the sides. Each cap has an oil grooving operation that follows the operation of sawing it from the base.

The first operation is to mill the bottom face, or foot, of the bearing on a 2B, Cincinnati machine as in Fig. 1. The time is 3.4 min. The bronze casting is held in special jaws in the regular machine vise. Two holes are next drilled in the base and three in the top in the fixture shown in Fig. 2, by turning it in two positions. The clamps *A* and *B* have forked ends to permit the drill to pass through in drilling the feet. The clamps are easily operated by the star nuts shown underneath. The time for drilling all 5 holes is under 5 min. Two dowel holes are then drilled and reamed in both top and bottom on a single spindle machine in 4 min. and the metal around the two holes on top is spot faced.

The upper faces of the feet are next milled, as in Fig. 3. The fixture holds four bearings and is reversible so as to mill both sides at the one setting. The index pin is shown at *A*.

A hand milling machine is used to cut the cap from the base, the bearing being held in the fixture shown in Fig. 4. The bearing is clamped by the feet, which are located by the dowel holes. The sawing operation is done in a trifle over 1½ min., floor-to-floor time. The center bearing has a relief cut in the side to allow



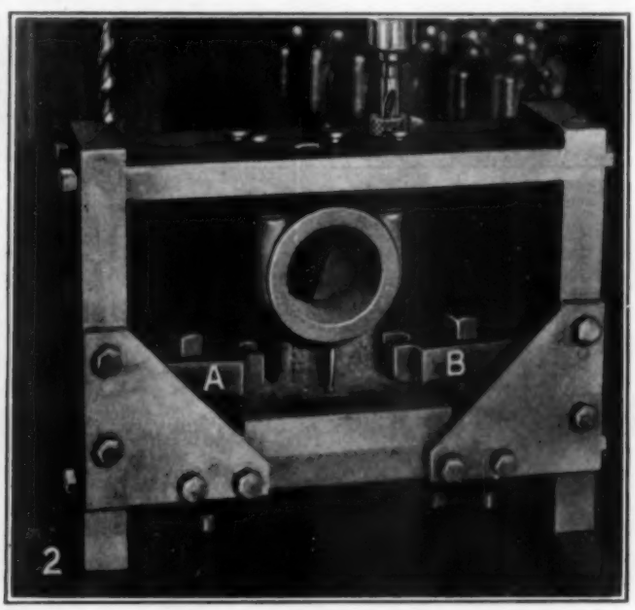
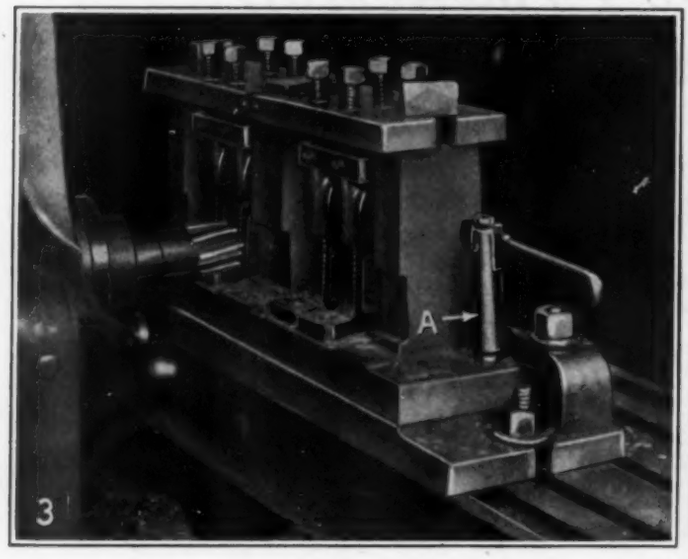


Fig. 1—Milling the base. Fig. 2—Drill fixture for top and bottom

Automotive Production



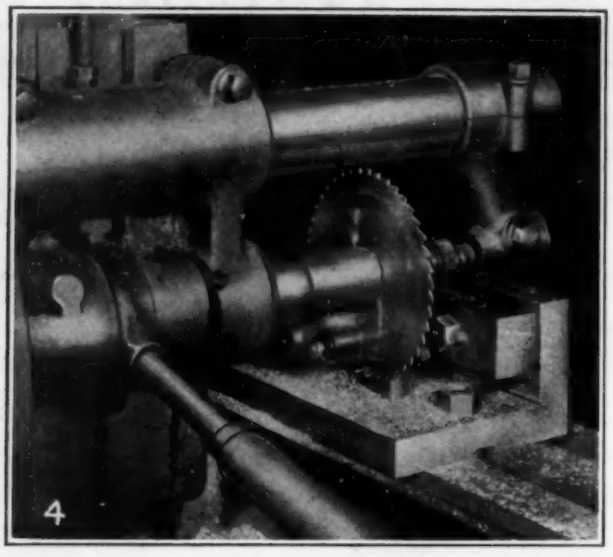
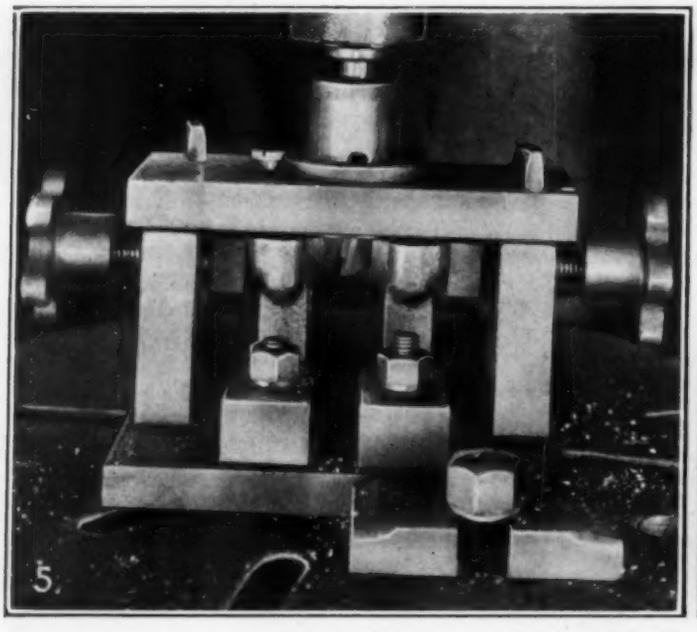


Fig. 3—Milling top of feet. *Fig. 4—Cutting off the caps*



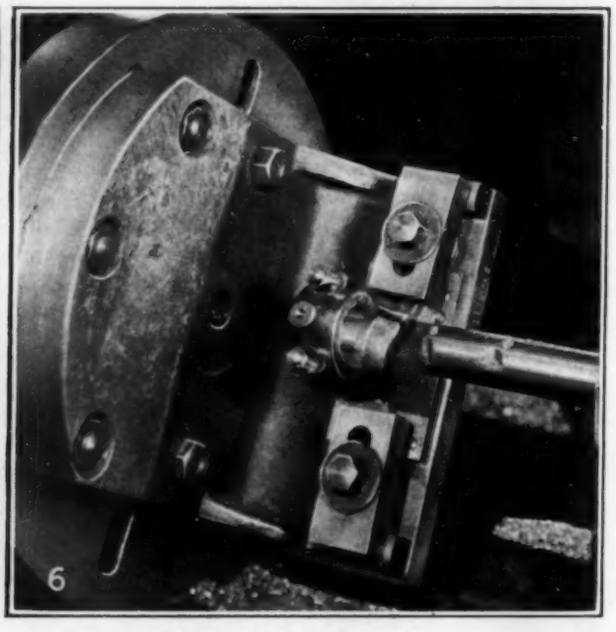


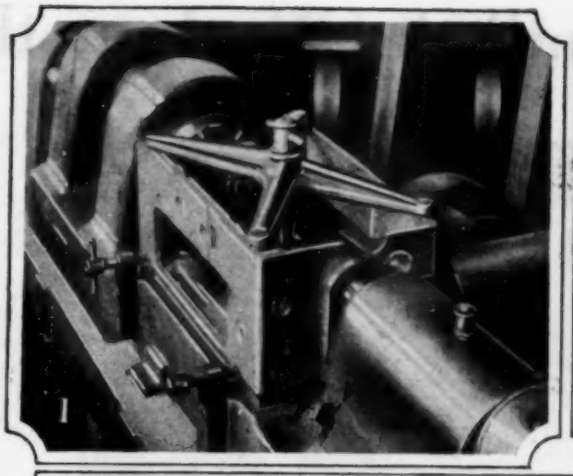
Fig. 5—Cutting side clearance. *Fig. 6—Boring the bearing hole*

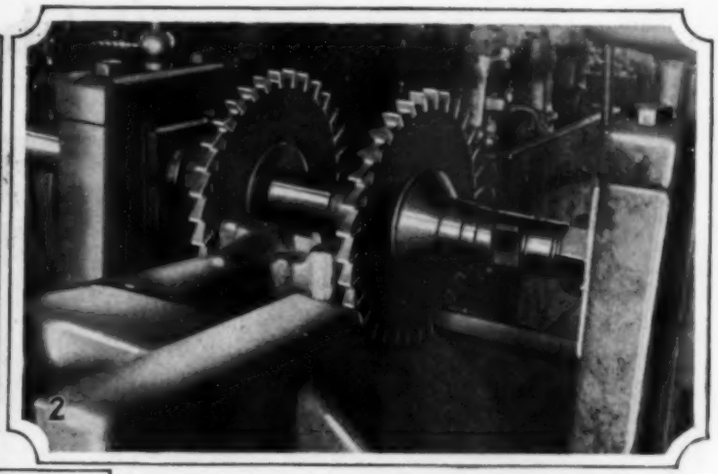
clearance for the valve guide. For this operation it is held in the fixture in Fig. 5, two bearings being bored at once. They are located by the dowel holes and clamped by the feet. Side thrust of the cutter is taken by the blocks at each end of the fixture. The cutter is well supported in a top bushing. The operation is completed in 2.6 min. for the two bearings.

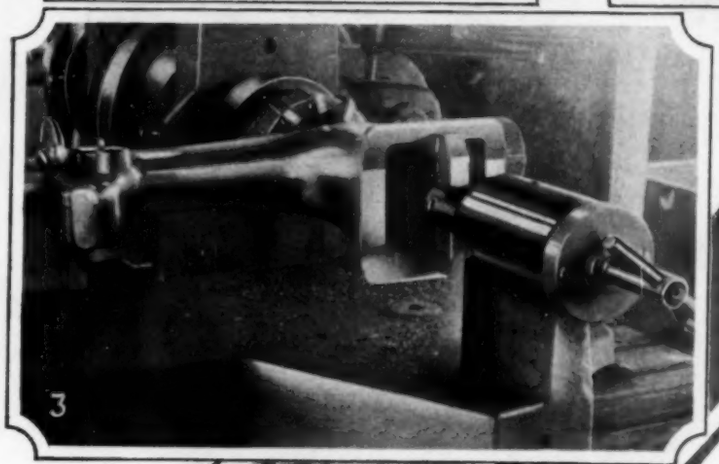
Both the cap and base have the joint faces disk ground on a Besly machine, the two operations being performed in 1½ min. After inspection, they go to stores from which they are drawn, together with studs, nuts and dowels, for assembly into units. Studs and dowels are driven and caps assembled to bases, after which the hole for the camshaft is bored on a Cisco lathe in the angle fixture shown in Fig. 6. Here again the bearing is located by the dowels and clamped in position for boring. Two cuts are taken, both cutters being in the same bar, far enough apart to allow the first to clear before the second enters the cut. The time is 5.65 minutes.

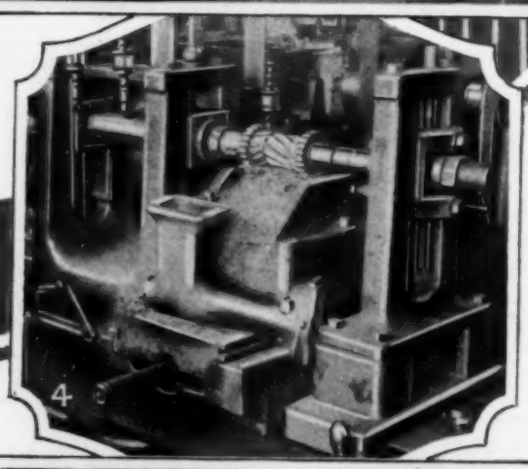
Following this operation, the hole is ground to size on a Heald full-automatic machine, after which the bearing is washed in a tank, inspected, and goes to stores ready to be drawn for final assembly.

Electric railways are now operating 4,400 buses, an increase of over 600 per cent within a year. It is believed that these railways will eventually be the largest users of commercial vehicles in the world.









Some Singer Sewing-Machine Methods

1—Special boring and reaming machine for bases

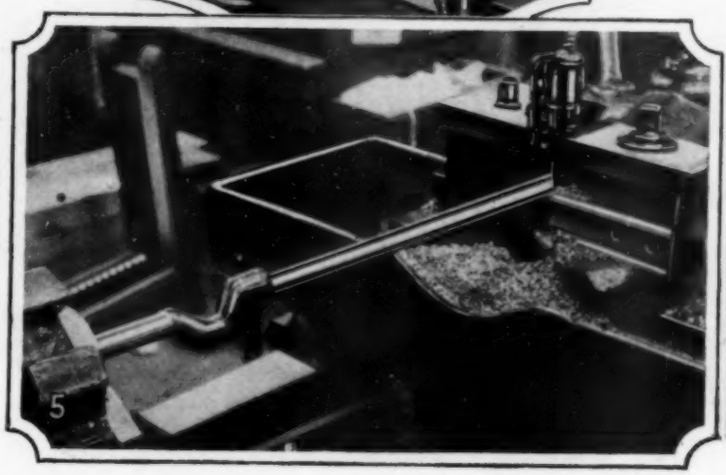
2—Straddle milling a head on Lincoln machine—Feed 4½ in. per min.

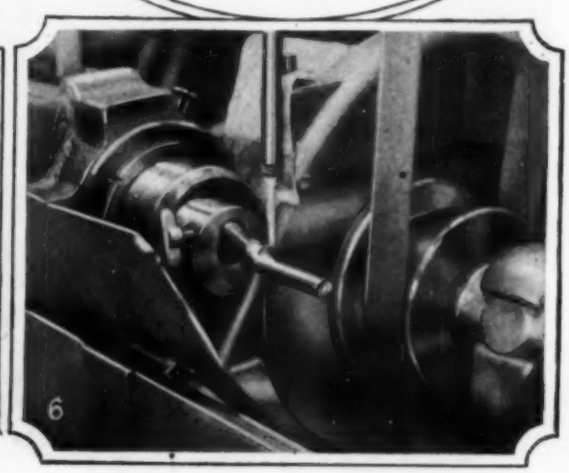
3—Milling top of frame—Note supporting bar at left, also equalizing clamp

4—Milling bottom of frame to leave tongue for base fit

5—Turning crankshaft—Note back rest with chip pan on carriage

6—Grinding throws or crankpins in special chuck





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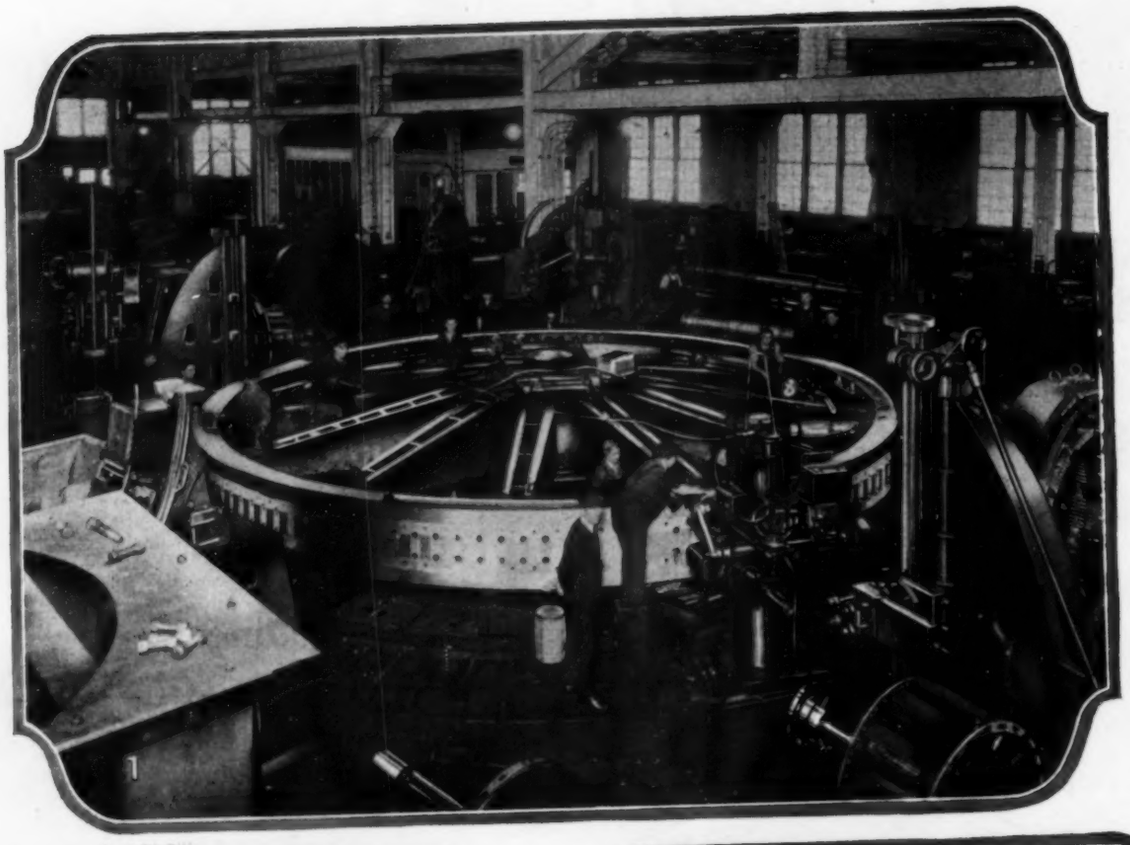
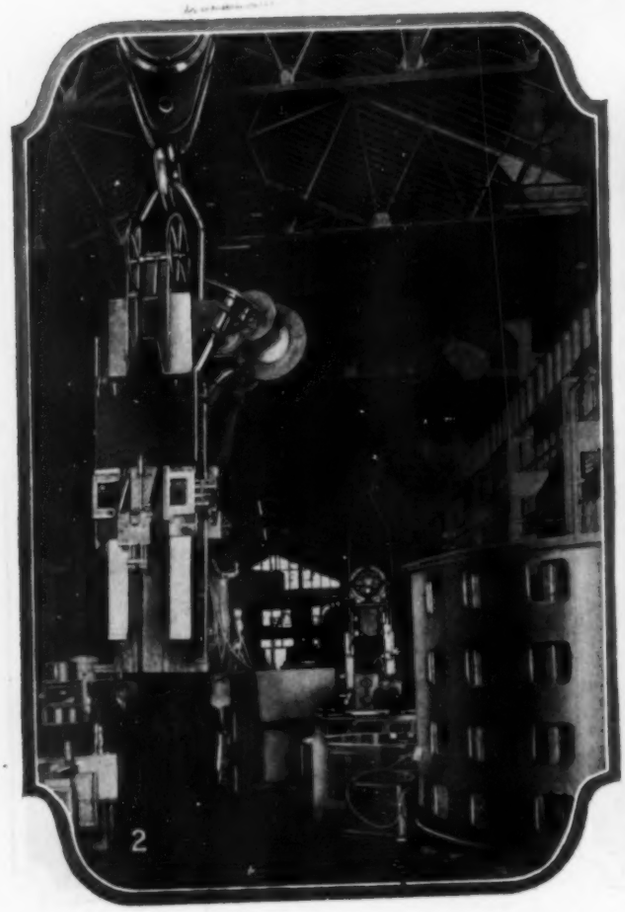
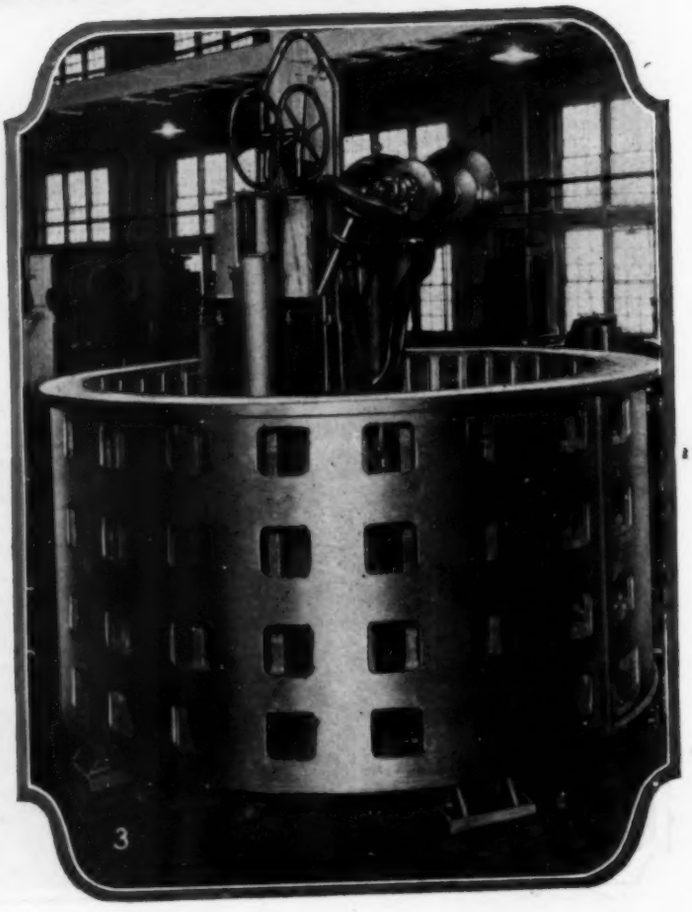






Machine Tool be Moved?

1—Machining the rim of a 30-ft. rotor

2—Moving a 5-ft. stroke slotter

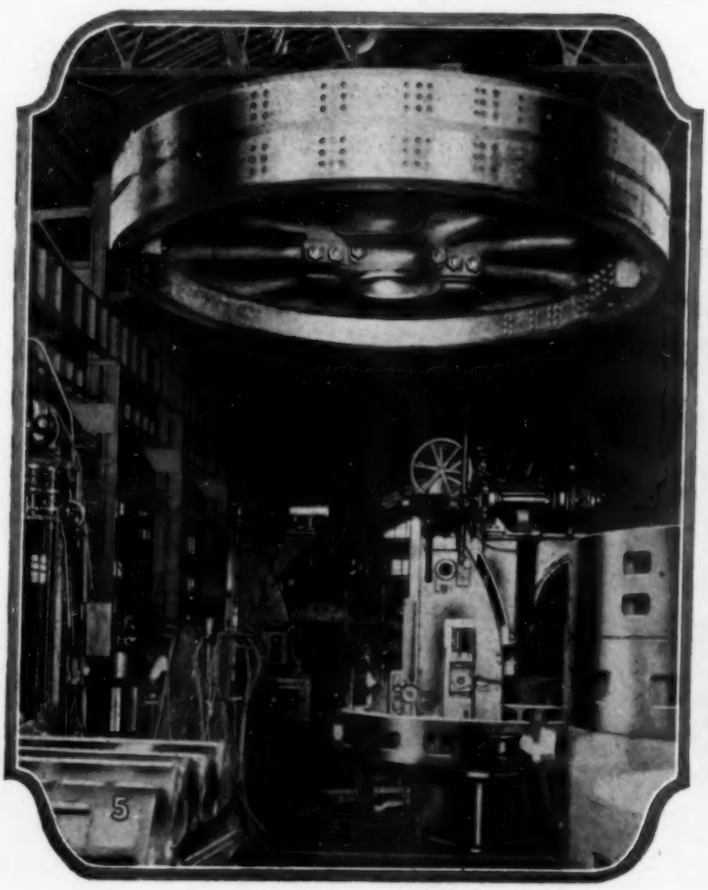
3—Slotter at work inside of generator casting

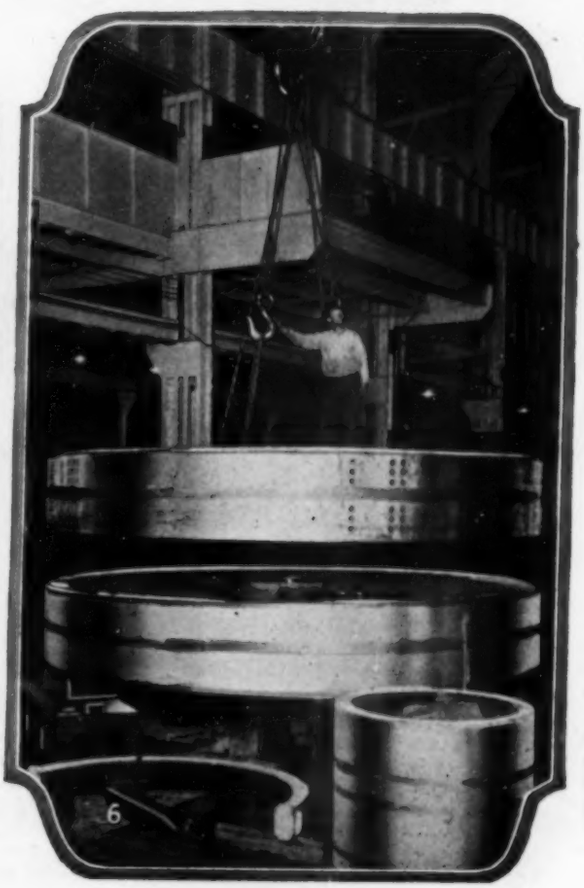
4—Milling slots in a heavy forging

5—A 19-ft. rotor, and a slotter at work on a large casting

6—Rotor being lowered on its mate

Photographs by courtesy of the General Electric Co.





2—Oil drums in pipe racks, and drip pans with guard rail in front

Progress in Methods of Storing Oil

1—Oil drum on wooden frame—Note waste of oil on floor and foot tracks

3—Front view of the pipe rack and guard rail

4—Modern tank storage with pumps — Tanks supplied from drums on track over tank at rear

Ideas from Practical Men

The Prevention of Loose Babbitt Metal Linings

BY L. D. ALLEN

Where a bearing lining of babbitt metal is to be placed in a rough cast-iron backing, the usual practice is to remove the hard crust or glaze, produced by the molding sand, by machining or grinding. The smooth surface obtained is not sufficient, however, to make the babbitt alloy adhere and it is necessary to provide dovetailed grooves for anchorage. These grooves, which are wider at the bottom than at the top, are cut by means of a milling machine.

In the case of brass and bronze backings and sometimes for cast-iron and steel shells, the tinning process is used. All glaze, dirt and other foreign matter is first removed. The usual method is to pickle the shells in a bath consisting of four parts water and one part muriatic acid. A clean surface results and tinning is then possible. In obstinate cases machining or grinding must precede the pickling operation. Grease can be removed by the use of gasoline or a hot solution of caustic soda.

A soldering fluid is necessary for tinning. For cast-iron and brass backings a good fluid can be made as follows: Cut 3 lb. of scrap zinc into small pieces and dissolve them in a solution of one gal. of muriatic acid in one gal. of soft water. Twenty-four hours should be allowed for the zinc to completely dissolve, the liquid being stirred occasionally. Two ounces of dry zinc oxide is added and the new solution is let stand for two more days. It is then filtered and four ounces of sal ammoniac, powdered, is finally added. For steel and cast iron this solution is improved by adding one quart of strong hydrochloric acid.

For tinning cold cast iron or steel dissolve one ounce of blue vitriol in eight fluid ounces of water. To this add eight fluid ounces of the above soldering solution. This liquid when brushed over clean cast iron or steel leaves a coating of metallic copper to which the solder adheres. The soldering iron must be red hot and it can be used before the coating is dry. If the operation is delayed oxidation will prevent adherence of the solder. The soldering fluid must be kept clean.

Ordinarily the surface is heated to 200 deg. F. and then cleaned with the regular soldering solution. The piece is then further heated over a fire or by plunging into a quantity of molten solder. In case it is warmed in molten solder, the solder will adhere to the prepared face and should be brushed over the surface with a soft brush so as to produce a mirror-like coating of solder. The solder used in the tinning process is usually the half-tin, half-lead grade.

When the method of warming over a fire is resorted to, the surface of the shell must be rubbed with a stick of solder and then brushed. The idea is to get a good coating of solder on the prepared surface. Heating the shell in melted solder produces the right temperature for tinning much quicker than the other method of heating. If the shell is too hot, however, it will not take the solder well.

The babbitt metal should be poured no hotter than is necessary to flow the casting. Babbitt metal is usually ready to pour when it heavily browns a pine stick. The backing against which it is poured and the mandrel should be heated, but not hot enough to sizzle or "spit" when a moistened finger is applied.

Bearing alloys expand on heating and contract on cooling. The higher the heat given the metal the greater the contraction on cooling, and consequently, the greater the structural or cooling stresses. These structural stresses form cracks in the liner, which widen under service and eventually lead to bearing failure. This condition is common in the case of high tin-base babbitts that are poured and applied at too high a heat, and against excessively hot shells or backings. Every bearing metal shrinks and, unless proper care is exercised in preparing the surface against which the metal is cast and in casting it at the proper temperature, the liner is very likely to contract or pull away from the backing, leaving a space into which the liner presses beneath the load. As a result it usually cracks and becomes loose. Even if it does not crack under journal pressure, an incessant vibration sets in that shatters the babbitt liner.

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Traffic Post on a Shop Floor

BY MILTON WRIGHT

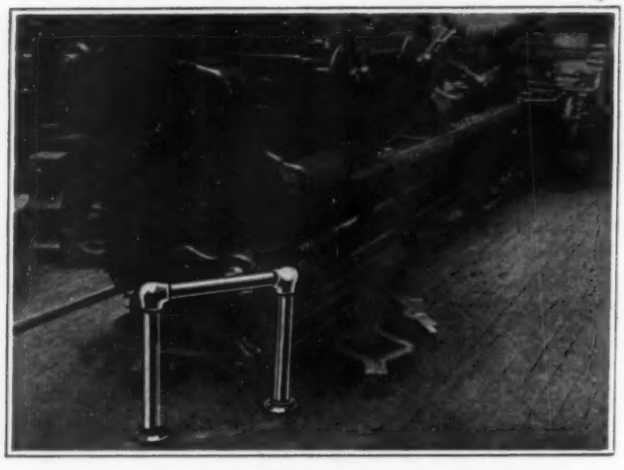
In a shop where there is much trucking of parts to be done, a machine that stands near the angle of intersection of passageways, as does the lathe shown in the accompanying picture, is liable to serious injury from trucks the operators of which, in their zeal to get their day's work done, are inclined to cut corners too closely.

In this shop there are many heavy parts to be moved, and the lathe stands at the intersection of two main aisles along which trucks are moving constantly. There are many hand-drawn trucks, and a few trucks operated by motor and storage battery. Though the smaller ones may be depended upon to cause their share of the trouble it is the larger and more swiftly moving power trucks that are more likely to bring about serious damage.

To obviate the possibility of smashing the gears of

the lathe or their casings by the trucks, the guard here shown was devised. It is constructed of iron pipe and fittings, and is anchored firmly to the floor.

The guard serves not only to protect the gear-box of the lathe from accident, but the operator of the lathe as well, since he is assured of a place in which he can



Truck guard on a shop floor

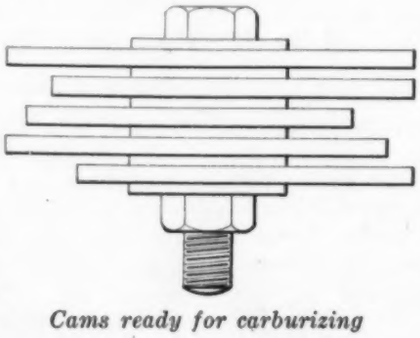
give undivided attention to his duties without fear of being run down. A passing workman, meeting traffic at the corner, is also protected against possible injury from accidental contact with the lathe.

There is a moral effect upon the truckman, as there is upon the motorist by the traffic post at the intersection of busy streets. The presence of the guard inspires him with a more caution than he might otherwise exercise, and he involuntarily swings wide when passing the corner.

Casehardening Screw-Machine Cams

BY H. J. GUSTAV KOPSCH

Every once in a while we are asked to caseharden a lot of cams for Brown & Sharpe automatic screw machines, and are always requested to leave the metal surrounding the hole soft, so that if the cams shrink in hardening, the holes can be reamed to bring them to size. Our practice is to string several cams on ¾-in. bolt, placing large washers between the cams and under the bolt head and the nut, as shown in the illustration.



Cams ready for carburizing

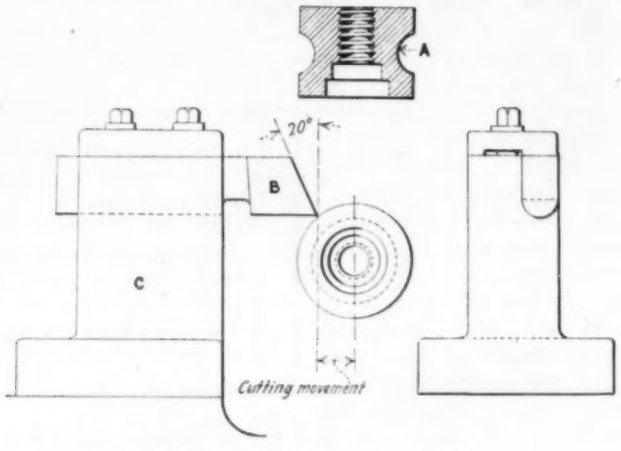
The whole stack is carburized as a unit. After carburizing, the cams are removed from the bolt, and each one is heated and quenched separately.

The cams are made of machinery steel, and carburization does not take place in the area covered by the washers, so that the metal around the holes is not hardened by quenching. This method has always produced satisfactory results.

An Overshot Forming Tool

BY HENRY T. DOWNS

The work *A*, shown in the illustration, was made from cast iron in two operations in a turret lathe. The work was first held by the outside in the chuck jaws, while the inside and one end were machined. In the second operation, the work was screwed onto an arbor, and the other end was faced, and the outside formed to shape. In order to simplify the operations, the pieces were cast in a bar 16 in. long, having a ¾-in. cored hole through the center. The bar was held in a 3-jawed chuck, and turned bored and tapped for



Details of the overshot tool

one piece. The outside was formed, and the piece cut off. The finest cross-slide feed on the machine, 0.004 in. per revolution, was too coarse for the forming cut and necessitated hand forming, which slowed up the production.

To permit power feed for forming, an overshot tool was made as shown at *B*, which left the operator free to manipulate the turret tools without worrying about the forming. The cast-iron toolblock *C* was made to hold the tool *B*, the front end of which was beveled at an angle of 20 deg. and the lower portion formed to the shape desired.

The tool worked very well indeed, giving a smooth cut, free from chatter, and, due to its position with respect to the work, the power feed was not too coarse. Some experimenting was necessary to determine the best cutting angle for the front end of the tool. The radius form was, of course, proportioned to give the proper curvature at this angle.

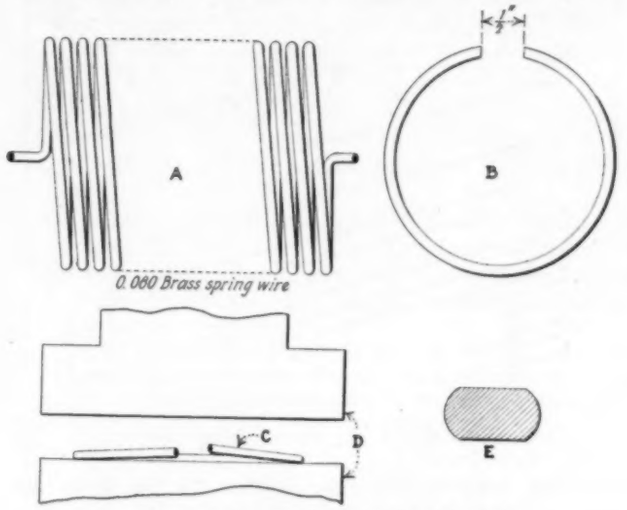
Before making this tool, I attempted to locate some information regarding overshot tools, but was unable to do so, therefore it appears that the subject may be of some interest to readers. The difficulty of determining the angle on the face of the tool is due, of course, to the constant change in relation to the center of the work as the tool moves forward. The deeper the formed cut, the greater the angle on the face of the tool must be. If any of your readers can give more information on this subject, it will be appreciated.

Metric threads are usually designated by the pitch, or distance between threads, in millimeters. In some cases the number of threads per centimeter is given in the same way as we say "threads per inch."

Straightening Snap Rings

By John D. Alexander

A short time ago we had a large number of snap rings about 3¼ in. in diameter to make from 0.080 brass spring-wire. First, we wound them on an arbor in regular coil-spring form as shown at *A* with the coils close together. Then they were put on another arbor and cut apart, as shown at *B*, leaving them offset, as at *C*, due to the spiral winding. A few of them were straightened by hand, laying them on a surface plate to test



How the rings were straightened

the flatness. This process was very slow, since it sometimes took nearly a minute to straighten one ring. I then got hold of a pair of hardened anvils, as at *D*, that were used for flattening work on the punch press, and, after experimenting on a few rings, we found that when squeezed, the round section became flattened as shown enlarged at *E*, resulting in a flat ring. No further straightening was required and the section *E* was perfectly satisfactory for the purpose.

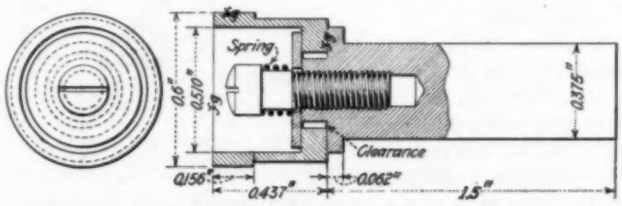
By this method we found it possible to straighten over 300 rings per hour as compared with 50 or 60 by the hand method. Also, the product was more uniform and better in general appearance.

A Self-Centering Test Button

By J. A. Wheatcroft

A tool that should prove to be very useful, is the self-centering test button shown in the illustration.

Instead of using a solid plug in the machine spindle when locating the positions of holes in relation to the spindle, the shank of the tool is held in a chuck. When the machine is started, the button will, of course, run out of true. If, however, contact is made between the revolving button and the surface of the work from



A useful test button

which the dimensions are to be taken, the button can be made to run true. After the button has been made to run true, the work can be moved any determined amount by the table screw, checking the movement by the graduations on the collar of the screw, or by a vernier attachment, if the machine is so equipped.

By reference to the sketch, it will be seen that the button is held in position by spring pressure. The diameter of the button should be very accurate, since all distances are figured from it.

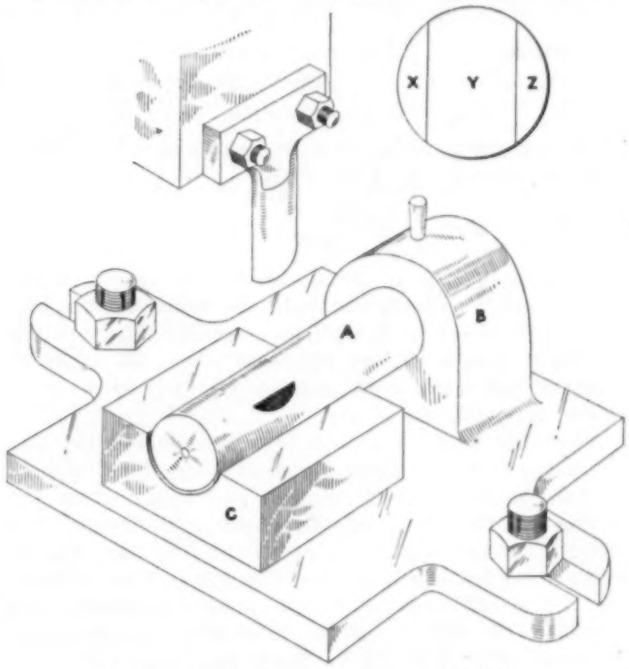
How Would You Do This Job?—Discussion

By Wallace Webster

The hole in the side of the steel tube shown by Henry Densmore on page 904, Vol. 63, of the *American Machinist*, can be pierced out on a special form of horn die, but not in one operation. I should make a three-operation job of it, but it might possibly be done in two. The sketch shows the tools.

The dies *A* — there should be three of them — are plain round bars of tool steel turned to fit the inner diameter of the tube to be pierced, the die openings filed out and the bars tempered and polished. The rear end of each bar should be made a light driving fit for the hole in the raised boss of the die-bed *B*, and they should be held therein by a substantial tapered dowel.

The die openings in two of them are lune-shaped, the curved side being of the same radius as the full hole to be pierced, intercepted by a chord. One should be right-



Tools for piercing hole in wall of tube

and the other left-handed, as at *X* and *Z* in the sketch. The opening in the third die should be shaped as at *Y* in the sketch, to complete the hole.

A carefully-made cradle of steel, as at *C*, has its half-round groove accurately fitted to the outside diameter of the tube to be pierced, and its thickness is such that when it has been slid under a tube that is placed on the die, it will just fill the space between the tube and the die-bed.

Suitable gages must be provided so that after the first opening has been pierced, the tubes can be reset in the succeeding operations to make the openings coincide properly with those already pierced.

Do not make the mistake of making the die-bars too short; no unsupported bar, however rigid, could support the strain of piercing a hole in such heavy metal. The weight of the blow falls upon the cradle, and through it is sustained by the die-bed. The slight springing of the bar as the slack is taken up, is what saves the bar from breaking.

Strength of Taper Pins

BY H. B. SCHELL

In order to facilitate the calculation of the shearing strength of taper pins, the accompanying chart was devised. It is applicable to standard Morse taper pins.

The diagonal lines on the chart show the diameter of the pins at any point given by its distance from the larger end, where the nominal pin diameter is measured. The scale on the right gives the permissible load in shear at one section that will result in a stress of 6,000 lb. per sq.in., the generally accepted working figure.

The total shear is first calculated by means of the following formula:

$$\text{Total Shear, } S = \frac{H \times 33{,}000}{\frac{d}{12} \times \pi \times V}$$

$$\text{or} \qquad S = \frac{H \times 126{,}000}{d \times V}$$

where H = horsepower

d = shaft diameter, inches

V = revolutions per minute.

For example: 18 hp. is to be transmitted by a shaft 2 in. in diameter at 1,000 r.p.m.

$$\text{Then} \quad S = \frac{18 \times 126{,}000}{2 \times 1{,}000} = 1{,}140 \text{ lb., about.}$$

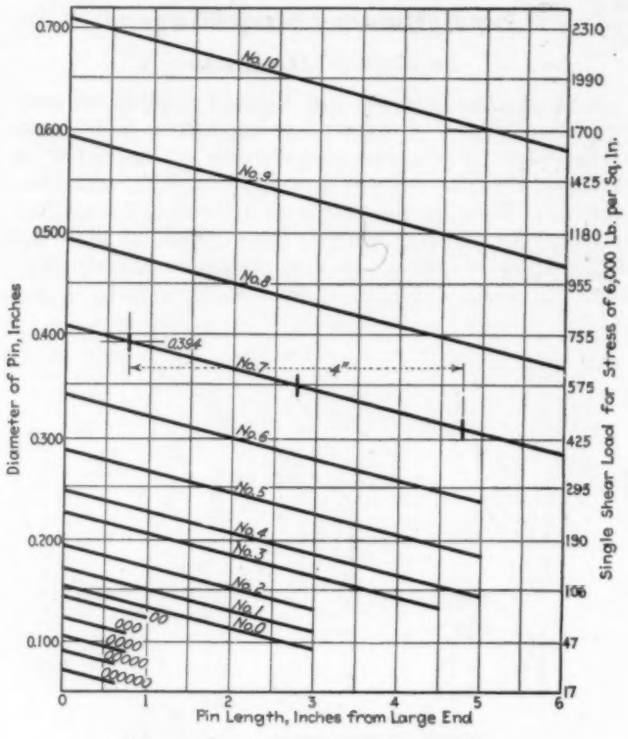
Since the pin is in double shear, the shear at one section will be considered half the total shear. The sections of shear in the pin are equidistant from the center of length of the pin, and since the taper is constant, the mean area of shear is equal to the area at the midpoint of the pin.

After the total shear has been found, and the size pin to use is sought from the chart, proceed as follows: Divide the total shear by two and locate from the figures on the right of the chart a horizontal line designating this shear value. Continuing the example given above let us assume that the hub is 4 in. in diameter. The half-shear is 570 lb., and a horizontal line representing 570 lb. shear intersects the No.-7-pin diagonal at a point 2¾ in. from the large end. The pin would then be cut off ¾ and 4¾ in. from the large end respectively and the taper hole would be reamed to 0.394 in. in diameter at its large end, since this figure is the diameter of the No. 7 taper pin at a distance of ¾ in. from the large end, as seen in the chart.

Conversely, to find the allowable shear on the mean area of a No. 8 pin, 5 in. long whose large end is driven flush, proceed as follows: The midpoint is 2½ in. from the large end, and reading across from the point where the diagonal representing a No. 8 pin intersects the vertical line representing 2½ in. from the large end, we find the answer to be 913 lb. The total shear is then 1,825 lb., and, given the shaft diameter and the r.p.m., it is a simple matter to solve the equation given above for the horsepower that the pin will safely transmit. Assume that the shaft is 2¼ in. in diameter and that the speed is 600 r.p.m. Then

$$H = \frac{1{,}825 \times 2.25 \times 600}{126{,}000} = 19.5 \text{ hp.}$$

or roughly 20 horsepower.



Shear chart for Morse taper pins

A Convenient Dipping Hook for the Soda Tank

BY H. L. WHEELER

A piece of ⅜-in. cold-rolled steel, bent as shown in the illustration, makes a very useful and inexpensive dipping hook for use in washing cutters, gear blanks and similar work in a hot solution of soda or lye. With such a hook, the workman's hands are protected from scalds and single pieces can be handled more quickly than when using either a basket or a small wire.

One or two such hooks around the soda tanks will soon pay for the trouble in making them.

Cleaning tools and small articles in a hot solution of soda or lye demands care on the part of the workman. The solution splashed on the skin may cause a painful burn.

A dipping hook for the soda tank

Types of Commercial Lock Washers

The function of a washer is to provide a bearing for a bolt head or nut. A lock washer is a washer intended to lock the nut or bolt in position, and prevent movement or looseness of the bolted parts. Lock nuts and nut locks usually perform the first function only, and do not prevent general looseness.

The lock washer has become the standard means of providing permanency in bolted construction. A lock washer consists essentially of one complete turn of a helical spring. It is placed between the nut and the piece to be fastened. When the nut is screwed down tightly, the washer is flattened out, and its elasticity produces a pressure upon the nut, thereby preventing backing off.

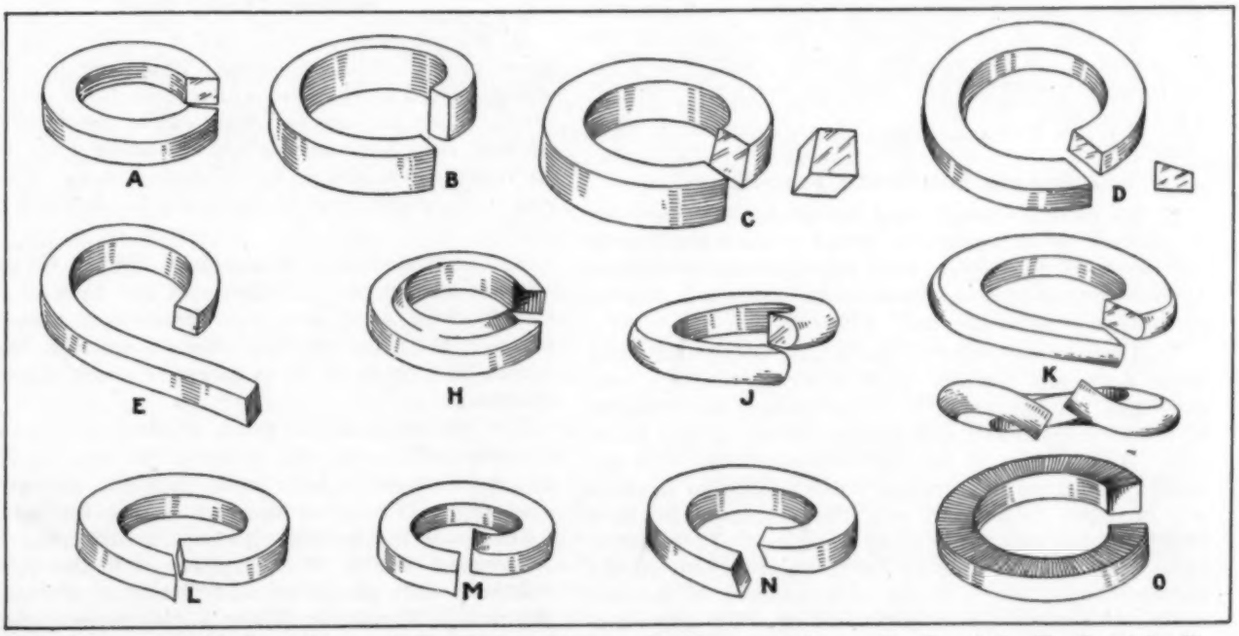
Lock washers are usually made of high-carbon steel, but the heavy types for railroad track work are sometimes made of special alloy steels. In Table I are shown the sizes of steel usually employed in commercial lock washers, and in Table II is given the application of these sizes to the S.A.E. standard lock washers. A lock washer is specified by the diameter of the bolt or screw with which it is used, but the hole in the washer is actually larger than the bolt diameter. Most of the lock washer manufacturers produce regularly washers for screw sizes from No. 2 to No. 12, and for bolts from ¼ to 1½ in. Washers are also on the market in sizes up to 3-in. diameter.

Table I—Classification of Steel Sections

Group 1	Group 2		Group 3	Group 4	
0.022 x 0.022	1/64 x 1/16		1/64 x 1/64	7/32 x 1/16	
1/32 x 0.022	1/64 x 1/64		1/16 x 1/16	5/32 x 5/32	9/32 x 1/4
1/32 x 1/32	3/32 x 1/16		1/32 x 3/32	1/4 x 1/16	9/32 x 9/32
3/64 x 1/32	3/32 x 1/64		1/32 x 1/32	1/4 x 1/4	11/32 x 7/32
3/64 x 3/64	3/32 x 3/32		7/32 x 3/32	1/64 x 5/32	1/16 x 1/16
1/16 x 1/32	1/8 x 1/16		3/32 x 1/8	1/64 x 1/16	1/16 x 1/4
1/16 x 3/64	1/8 x 3/64		1/4 x 3/32	1/64 x 1/64	1/16 x 9/32
1/16 x 1/16	1/8 x 3/32	1/64 x 1/16	1/4 x 1/8	1/16 x 1/8	1/16 x 1/16
3/64 x 1/32	1/8 x 1/8	1/64 x 1/8		1/16 x 3/32	1/16 x 3/32
3/64 x 3/64	5/32 x 3/64	1/16 x 1/16		1/16 x 1/16	1/8 x 1/4
3/32 x 3/64	1/16 x 1/16	1/16 x 3/64		1/16 x 3/32	1/8 x 1/16
1/8 x 1/32	5/32 x 3/32	1/32 x 3/32		1/16 x 1/4	1/8 x 5/16
1/8 x 3/64	5/32 x 1/8	1/16 x 1/8		1/16 x 1/16	5/16 x 1/4
	3/16 x 1/16	1/16 x 3/32		3/32 x 1/16	3/16 x 1/16
	3/16 x 3/32	1/16 x 1/4		3/32 x 3/32	3/16 x 1/4
	3/16 x 1/8	1/16 x 5/16		1/8 x 1/16	1/4 x 1/16
	1/4 x 1/16	3/32 x 1/16		1/8 x 1/8	1/4 x 1/4
	1/4 x 3/32	3/32 x 1/8		1/8 x 3/32	5/16 x 1/16
	1/4 x 1/8	1/8 x 1/16		1/8 x 1/4	5/16 x 1/4
	1/4 x 1/4	1/8 x 1/8		5/32 x 1/16	3/8 x 1/16
	5/16 x 1/16	1/8 x 3/32		5/32 x 1/8	3/8 x 1/4
	5/16 x 1/8	1/8 x 1/4		5/32 x 5/32	7/16 x 1/16
	5/16 x 5/32	5/32 x 1/16		3/16 x 1/16	7/16 x 1/4
	5/16 x 1/4	5/32 x 1/8		3/16 x 1/8	1/2 x 1/16
	3/8 x 1/16	5/32 x 5/32		3/16 x 5/32	1/2 x 1/4
	3/8 x 1/8	5/32 x 3/16		3/16 x 3/16	9/16 x 1/16
	3/8 x 5/32	5/32 x 1/4		3/16 x 1/4	9/16 x 1/4
	3/8 x 3/16	3/16 x 1/16		1/4 x 1/16	5/8 x 1/16
	3/8 x 1/4	3/16 x 1/8		1/4 x 1/8	5/8 x 1/4
	7/16 x 1/16	3/16 x 5/32		1/4 x 5/32	11/16 x 1/16
	7/16 x 1/8	3/16 x 3/16		1/4 x 3/16	11/16 x 1/4
	7/16 x 5/32	3/16 x 1/4		1/4 x 1/4	3/4 x 1/16
	7/16 x 3/16	1/4 x 1/16		5/16 x 1/16	3/4 x 1/4
	7/16 x 1/4	1/4 x 1/8		5/16 x 1/8	13/16 x 1/16
	1/2 x 1/16	1/4 x 5/32		5/16 x 5/32	13/16 x 1/4
	1/2 x 1/8	1/4 x 3/16		5/16 x 3/16	7/8 x 1/16
	1/2 x 5/32	1/4 x 1/4		5/16 x 1/4	7/8 x 1/4
	1/2 x 3/16	5/16 x 1/16		3/8 x 1/16	15/16 x 1/16
	1/2 x 1/4	5/16 x 1/8		3/8 x 1/8	15/16 x 1/4
		5/16 x 5/32		3/8 x 5/32	1 x 1/16
		5/16 x 3/16		3/8 x 3/16	1 x 1/8
		5/16 x 1/4		3/8 x 1/4	1 x 5/32
		3/8 x 1/16		7/16 x 1/16	1 x 3/16
		3/8 x 1/8		7/16 x 1/8	1 x 1/4
		3/8 x 5/32		7/16 x 5/32	1 1/16 x 1/16
		3/8 x 3/16		7/16 x 3/16	1 1/16 x 1/4
		3/8 x 1/4		7/16 x 1/4	1 1/8 x 1/16
		7/16 x 1/16		1/2 x 1/16	1 1/8 x 1/8
		7/16 x 1/8		1/2 x 1/8	1 1/8 x 5/32
		7/16 x 5/32		1/2 x 5/32	1 1/8 x 3/16
		7/16 x 3/16		1/2 x 3/16	1 1/8 x 1/4
		7/16 x 1/4		1/2 x 1/4	1 1/4 x 1/16
		1/2 x 1/16		9/16 x 1/16	1 1/4 x 1/8
		1/2 x 1/8		9/16 x 1/8	1 1/4 x 5/32
		1/2 x 5/32		9/16 x 5/32	1 1/4 x 3/16
		1/2 x 3/16		9/16 x 3/16	1 1/4 x 1/4
		1/2 x 1/4		9/16 x 1/4	1 5/16 x 1/16
				5/8 x 1/16	1 5/16 x 1/8
				5/8 x 1/8	1 5/16 x 5/32
				5/8 x 5/32	1 5/16 x 3/16
				5/8 x 3/16	1 5/16 x 1/4
				5/8 x 1/4	1 3/8 x 1/16
				11/16 x 1/16	1 3/8 x 1/8
				11/16 x 1/8	1 3/8 x 5/32
				11/16 x 5/32	1 3/8 x 3/16
				11/16 x 3/16	1 3/8 x 1/4
				11/16 x 1/4	1 7/16 x 1/16
				3/4 x 1/16	1 7/16 x 1/8
				3/4 x 1/8	1 7/16 x 5/32
				3/4 x 5/32	1 7/16 x 3/16
				3/4 x 3/16	1 7/16 x 1/4
				3/4 x 1/4	1 1/2 x 1/16
				13/16 x 1/16	1 1/2 x 1/8
				13/16 x 1/8	1 1/2 x 5/32
				13/16 x 5/32	1 1/2 x 3/16
				13/16 x 3/16	1 1/2 x 1/4
				13/16 x 1/4	

Table II—S.A.E. Standard Lock Washers

Group	Screw or Bolt Size	Fillister Head Screws	Round Head Screws	S.A.E. Bolts
		Steel Size	Steel Size	Steel Size
1	2	3/32 x 0.022	3/32 x 3/32	
1	4	3/32 x 3/32	1/16 x 3/32	
1	6	3/64 x 3/32	3/64 x 3/32	
1	8	3/64 x 3/64	3/64 x 3/64	
1	10	1/16 x 3/64	3/64 x 3/64	
1	12	1/16 x 1/16		
2	12		3/32 x 1/16	
2	1/4			3/32 x 1/16
2	5/16			1/8 x 1/16
2	3/8			1/8 x 3/32
2	7/16			3/32 x 1/8
2	1/2			5/64 x 1/8
2	5/8			1/16 x 1/8
3	3/4			5/64 x 3/32
4	7/8			3/32 x 1/16
4	1			1/8 x 1/16
4	1 1/8			5/64 x 1/16
4	1 1/4			1/16 x 1/8
4	1 3/8			1/16 x 1/4
4	1 1/2			1/16 x 1/4
4	1 5/8			1/16 x 1/16
4	1 3/4			1/8 x 1/16



Types of commercial lock washers. A, B—Plain patterns. C—Keystone shape. D—Beveled. E—Special. H—Rib pattern. J, K—Alloy-steel track types. L, M, N—Positive patterns. O—"Neverslip" patented

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Non-Rusting Steels

Q. Can you tell me how non-rusting steel derives its "properties"?

A. Non-rusting steels contain from 12 to 15 per cent of chromium, which gives to the steel its capacity for resisting corroding influences. The chromium-steels, however, are distinct from certain other non-corroding alloys which contain chromium, nickel, or cobalt, but have little or no iron.

Preserving Plated Parts in Stores

Q. Many of the parts which we make in our shop are plated, and we would like to have advice as to an oil or grease to be applied to preserve the finish while the parts are carried in the storeroom.

A. The large platers' supply companies do not recommend any oil or grease for this purpose. The theory is that any oil will either gum or collect dust, and it is more practical to store the parts in a dry storeroom without grease or oil.

Boxes of small plated parts stored for long periods are covered with paper, and it is usual to place sheets of paper between the layers when larger parts are stacked in trays. Caution is always given to see that plated parts are thoroughly dried before they are sent out of the plating room. This is accomplished by having a drying oven heated by coils of steam pipe. Small parts after plating are dumped into boxes of sawdust that are kept at an even heated temperature in the drying oven. When removed after a short period the parts are thoroughly dry, and the sawdust does not adhere to them.

Making Duplicate Tracings

Q. We have a request from one of our customers for a complete set of Janney or Baker process tracings of our machines. We do not have any information relative to these process tracings, and would appreciate any information you can give us.

A. These names refer to two of the "lithoprint" processes developed for the duplication of tracings, and drawings. A lithoprint is a true-to-scale reproduction of a drawing, printed with permanent ink on any material. A lithoprint on tracing cloth saves the cost and liability of error in retracing when additional tracings are required to be sent out. Some companies have lithoprint tracings made of all drawings. These duplicates are then stored in vaults in order to prevent the embarrassment which would be occasioned by the loss or destruction of the original tracing. On large contracts, also, it is becoming customary to call for the submission of lithoprints instead of duplicate tracings, since they are facsimile copies and will eliminate any cause of discussion due to slight differences in retracings. It is impossible for even the same draftsman to make the "duplicate" tracing exactly like the original. Lithoprint tracings cost slightly more than Vandykes, but the cost is only a small part of the expense of retracing and checking an original tracing.

Lithoprints are also made on tracing paper, on cloth, or on white paper. The latter are not much more expensive than good blueprints. They are usually mounted and varnished, and find their greatest application in shops where an ordinary blueprint would become rapidly illegible from dirt and grease.

Lithoprints can also be prepared from positive Vandyke prints, but not from blueprints. The method of making lithoprints is somewhat similar to the lithographic process. A special composition is poured onto the lithoprint table, and when cool forms a smooth, mirror-like surface. There is then prepared a special print on transfer paper, which is laid face down on the table. When removed it leaves etched on the surface a perfect image of the original. The surface is inked with a hand roller, and the material to be printed is laid on it in the same manner as for a lithograph operation.

Some of the large manufacturing plants find it advisable to install a complete lithoprint equipment, but for the factory that has only occasional need for lithoprints it is more economical to have the work done outside.

Milling a Long Rack

Q. We are cutting racks with a rack cutting attachment on the milling machine. The racks are of cold-rolled steel, 4 pitch, 3 in. wide, 1¼ in. thick, and 58 in. long. When we take the racks out of the fixture after cutting, they have sprung approximately 1 in., and we have great difficulty in straightening them. Have you any suggestions how to overcome the bending of the racks?

A. Cold-rolled steel is especially difficult to machine without distortion. In this case you have an exceptionally long rack, and you are cutting almost half through the steel section. We do not feel that the spring of 1 in. in 58 in. is excessive under the circumstances.

You can use a higher grade of steel, or increase the thickness of the section, or both, but this change will add much more to your costs than the straightening operation. If you cut the rack at one setting in the fixture, and the holding clamps are sufficiently strong to prevent spring of the piece until the jaws are released, there should be no difficulty in straightening the rack by the action of the holding screws when it is screwed to the machine. If, however, the clamping jaws are weak, and permit spring under the cut, the rack teeth will not be accurate when the rack is straightened.

Technical Abstracts

German Gear Standardization

Chief Engineer Greuner in Essen gives a review of German efforts at gear tooth standardization. The tendency appears to be to adopt an involute with a 20-deg. pressure angle for all purposes, an addendum height equal to the module as in the Brown & Sharpe system, and to allow at the top and the root of the tooth a sufficient deviation to secure smooth contact in spite of unavoidable inaccuracies of manufacture. This conclusion is based on a great amount of previous research discussion and industrial criticism both in Germany and in other countries.

The article also emphasizes the importance of wormgear standardization, since worm hobs are costly and mean much tied-up capital. The general feeling of the standardizing committees concerned seems, however, to have been to leave this matter to the gear manufacturers to settle. The article gives a drawing of the proposed standard gear tooth.

In a more general discussion Dr.-Eng. Bauersfeld, Chairman of the gear tooth committee of the German Standardizing Organization, voices among other things the opinion that American gear standardization is miscarrying from the point of view of simplification. Three tooth forms are allowed; the 14½ deg. full height, the 20-deg. full height and the 20-deg. stub. This enables the makers to meet individual preferences very readily, but no economies are secured to the industry. The Germans in settling on a final system, the 20-deg. full height, will in time derive substantial economic advantages.—*Maschinenbau*, March 18, pp. 255 and 258.

Welding

For welding it is important that high quality material be used for the best results, and, therefore, fire box steel, which is the best grade, is most suitable for important work. Such material according to standard specifications, may have a tensile strength of from 55,000 to 65,000 lb. per sq.in. and a minimum yield point of one-half the tensile strength. Material for welding should contain not over 0.15 per cent carbon.

With welded joints, the strength of the weld when made with any particular welding material cannot be varied, assuming, of course, good workmanship. For instance, the strength of the weld metal in a fusion weld, when made with ordinary low-carbon steel welding wire and of the double V-type, is about 50,000 lb. per sq.in. If the tensile strength of the plate be 50,000 lb. per sq.in. the efficiency of the joint would be 100 per cent. If, however, the strength of the plate is greater, the efficiency of the joint will be less. It is obvious that a welder who makes his test welds in a 50,000-lb. plate, by reinforcing his welds as is usually done, can break the plate, while another welder using a plate of higher tensile strength may have his test pieces break in the weld. It would be quite unfair to the latter man to say that because his pieces broke in the weld his ability was inferior to that of the man whose pieces broke outside the weld. S. W. Miller in *Journal of the American Welding Society*, April, 1926, p. 40.

Apprenticeship

The manual art of apprenticeship has been in vogue throughout the ages, coming down through the guilds of old to the more modern methods of today. Manufacturers and educators have experimented from time to time as to the best means of educating and bringing up workmen to carry on a given industry. Many feel that mass production of today which has developed the operator trained to single operations, has eliminated the necessity for the man trained to do everything. Nevertheless, there is a constant complaint that there is a shortage of skilled labor. The fact is that there is need today not only for the skilled operator who is able to handle all kinds of jobs on one type of machine, but for skilled workmen who can turn their hands to any job that they may be called upon to do.

School training when successful prepares a man to obtain the advantages of shop training in a much shorter time than is apt to be the case with an untrained mind. No matter how well the school shop training is carried out, however, it can in no way take the place of actual shop conditions.

Apprentices in a shop should be under a supervisor and the selection of the proper supervisor is an important thing. He must be not only a thoroughly trained mechanic but he must also be a man of character, capable of handling his job sympathetically and must be able to keep the boys enthusiastically interested in their work. W. A. Viall of Brown and Sharpe Manufacturing Co., in *Mechanical Engineering*, May, 1926, p. 409.

Salt Bath Furnaces

In the efficient operation of a salt bath for the heat-treatment of metals it is necessary to have a properly designed furnace to obtain maximum production at lowest cost. Often an improperly designed furnace will mean a complete failure of a heat-treating process employing salt baths. In such cases, it is unfortunate that the salt bath process itself is blamed for the failure, whereas, usually it is a question of furnace design and operation. A test of a salt bath is not a fair test unless the furnace used in the test is properly designed and properly operated. The pot or container used for the salt should be considered as a part of the furnace.

It is a fallacy to consider that a heated liquid is of the same temperature throughout. The convection currents in a molten bath are the natural result of nonuniformity of temperature in that bath. A molten bath is continually losing heat at the top by radiation into the atmosphere and when in use, by the carrying away of heat with the work. Normally, then, there will be a tendency toward a higher temperature at the bottom of the bath than at the top, in spite of the fact that convection currents continuously carry the colder liquid to the bottom. Sam Tour of the Doehler Die Casting Co., in *Forging-Stamping-Heat-Treating*, May, 1926, p. 173.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

A Museum of the Peaceful Arts

ABOUT the only industrial nation that cannot point to a museum devoted to exhibits showing the advances made in machinery and tools is the United States. Various attempts have been made to raise funds for such an institution but without much success. Realization finally seems at hand through the Towne bequest of two and a half millions for a Museum of Peaceful Arts to be situated in New York City.

Now that funds are assured the question is how best to apply them. To solve this problem the trustees of the foundation have retained Professor Joseph W. Roe of New York University to develop a plan. Professor Roe's outline is published as the leading article in this issue. He wishes his scheme to be considered as tentative and invites criticism. In addition, any information leading to the securing of units for inclusion in the various groups mentioned will be most welcome. Please study the outline as printed and write to Professor Roe, or to the "American Machinist," giving what suggestions occur to you.

Co-operate with Your Legislators

IS IT possible to co-operate with a legislator and stay out of jail? Some business men seem to fear not, judging from the way they avoid their elected representatives in the federal and state legislative bodies. Such an attitude is extremely shortsighted and goes far to explain why so many legislative enactments are unsatisfactory to business men. But can the complaining business man blame anyone but himself when laws that he does not like are passed, if he has not lifted a finger to give the legislators his opinion on the questions at issue?

How ready the modern legislature is to respond to pleas for help, reinforced by constructive suggestions that will solve their own problem and aid the community in general, is shown by a recent experience in New York State, according to a statement made by Merwin K. Hart at a recent convention. Several representative business men met with leaders of the legislature and pointed out to them how taxes on industry were being increased, how restrictive measures of all sorts were being added to, how certain industries had had to leave the state because of ruinous competition from states where restrictions were less. The result was the passage of a resolution setting up a commission to investigate the industrial situation in New York State. Whether the legislature, while waiting for the commission to report, will accede to the request that it pass no more laws restricting industry until the report is in, is an open question. In view of the attitude taken by the legislature in appointing the commission there is reason to hope that it will so restrain itself.

As Mr. Hart said, much legislation has been passed without sufficient facts, and more has been offered. It is distinctly up to business men to make sure that the legislatures of their states have the facts they should have before they act on laws that affect industry. There is much encouragement in the experience in New York.

Good Lighting Decreases Useless Work

WE LUBRICATE engines, we polish bearings, we align shafts and in many other ways we reduce the useless work done by the machines which we build and operate. Similarly, we systematize and simplify operations and in manifold ways we aim to reduce the useless work of human beings. Useless work is done at the expense of useful work. It is a dead loss and it is often annoying and even harmful whether done by a steam engine, an electric motor, a machine tool or a human being.

Notwithstanding, the overwhelming importance of vision and the great advances in lighting possibilities, inadequate or improper lighting, or both, are still prevalent in our industries. Such conditions are taking a great toll in many ways and an important one is the reduction in useful work by the amount of useless work which the human being must do because he cannot see at his best. Under such conditions he does not see as easily, as quickly, or as accurately as he is capable of doing. He moves himself or his object to a better position. He may look more than once before he recognizes. Shadows or reflected high-lights may interfere with visibility. His visual apparatus is operating in "low" instead of in "high" as in the case of adequate illumination. He suffers the well-known effects of inadequate light and of glare from poorly designed lighting systems. All these and other factors convert muscular and nervous energy into useless work.

Here is an attractive field for increasing efficiency at no net cost in money or in human effort. Good lighting is not a lash which drives the worker to do more total work, for the human engine is fairly well governed so that its average rate of work is more or less constant. A great reward for improving "seeing" conditions lies in reducing the useless work done by the human being thereby increasing the useful work without any increase in the total work.

Shop Equipment News

"Niles" Journal-Turning Lathe, 90-Inch

The Niles-Bement-Pond Co., 111 Broadway, New York, N. Y., has built the 90-in. journal-turning lathe, illustrated in Fig. 1, in the plant of the Niles Tool Works Co. Division, at Hamilton, Ohio. The machine was designed primarily for turning and burnishing inside and outside journals, but it can also be arranged for quartering and crankpin turning on locomotive wheels by means of special attachments. Fig. 3 shows the crankpin turning attachment.

The machine is furnished in the following combinations to suit different shop conditions: for inside journal turning only; for both inside and outside journal turning; for journal turning; and for single or double quartering, either with or without the crankpin turning attachment. Any or all of the attachments can be added to the original machine.

Power is transmitted from the driving motor on the headstock through a 6-in. belt to a jackshaft and thence to reduction gearing mounted at the back of the headstock. The faceplate is driven from a pulley on another jackshaft through a 10-in. belt running directly around the periphery of the faceplate. This drive is said to be more resilient than that obtained by gearing. It is claimed that a smooth finish, free from chatter or gear marks, is obtained. A tightener pulley is provided and is held in engagement with the belt by means of a compression spring. Also the driving motor is mounted on rails that permit the tightening of the driving belt from the motor to the jackshaft. Both belts are completely protected by sheet-iron guards.

A hand brake that is controlled by lever conveniently located on the front of the headstock acts directly on the rim of the faceplate and is used for stopping the faceplate in the most convenient position for putting in or taking out the wheel set. An adjustable extending member projects out between the spokes of the driving wheel and clamps around a spoke. Its position can be adjusted readily on the faceplate for different sizes of driving wheels. A pear-shaped opening is provided in the faceplate to receive the crankpin.

In order to assure accuracy and trueness of journals, both ends of the axle are carried on non-rotating or dead centers. It is claimed that this method has proved superior to mounting on revolving spindles and centers. The centers are heat-treated and are mounted in sliding spindles that can be clamped firmly in the headstock.

The heavy counterweights in the driving wheels exert considerable centrifugal force when revolving in a lathe for journal turning, and in order to counterbalance their effect and to assure true running of the

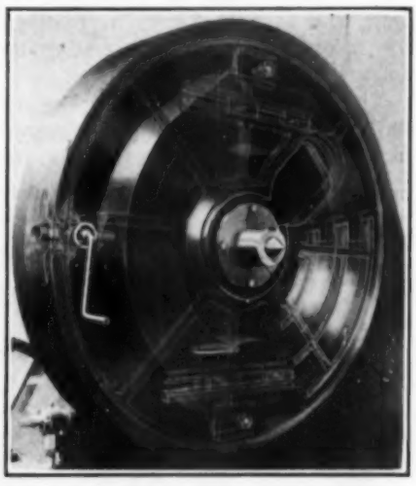

Fig. 2—Phantom view of the adjustable counterbalance

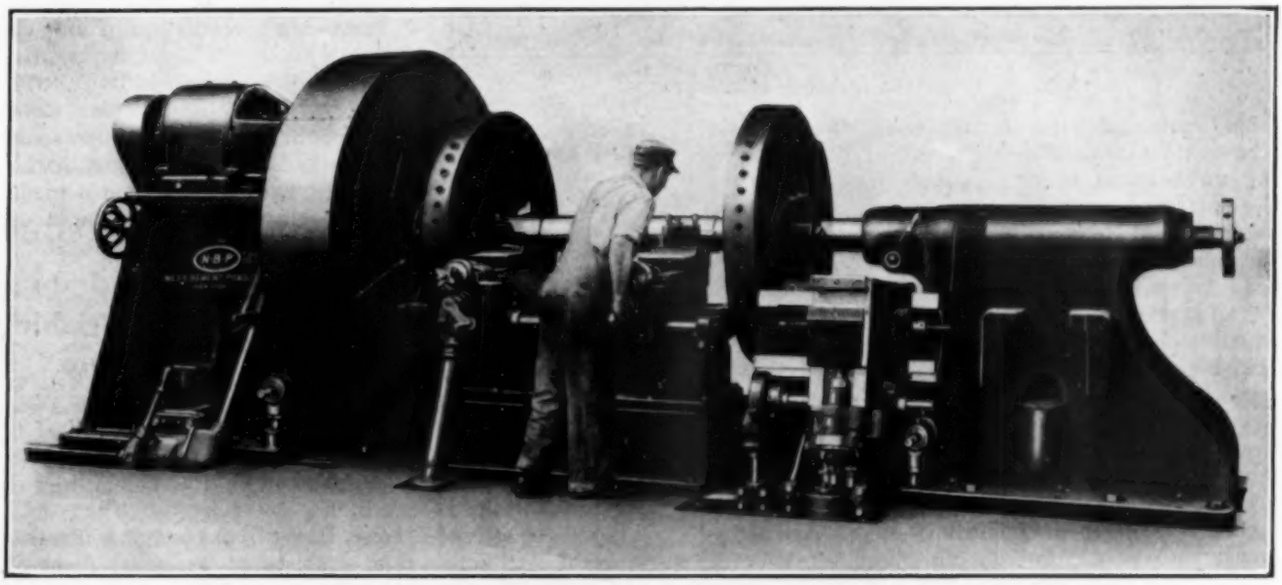

Fig. 1—"Niles" Journal-Turning Lathe, 90-Inch

Shop Equipment News

wheels, a counterweighting device has been placed in the faceplate. As shown in the phantom view, Fig. 2, the counterweight is located entirely within the faceplate with no outside projections. It is a single casting and has a single adjustment for different-size wheel sets. The adjustment is through bevel gears and a screw. A pointer in a slot shows the position of the counterweight from zero to maximum counterweighting, sufficient for the largest wheel sets. The counterweight is guided in T-slots and is held firmly in position by means of clamps operated by square head bolts.

The headstock and tailstock are both provided with power traverse along the bed by means of a separate 5-hp. motor driving a revolving screw in the bed. Eccentric clamping mechanisms operating at both the front and back of each member are provided for quickly clamping the headstock and tailstock to the bed.

The carriage consists of two compound toolrests mounted on a base bolted on the bed between the driving wheels. The toolholders are of the single-screw clamping type and are so constructed that the tools may be set at an angle. The rests are provided with power longitudinal feed for use in turning journals and power cross-feed for facing hub liners. The feeds are reversible and the changes are obtained through a feed box located on the headstock. Provision is made for engaging or disengaging the feed at the rests. Hand adjustment is provided also for both longitudinal and cross-travel. The rests are arranged to take burnishing rollers, which are furnished with the machine. The cross-feed screws have ball thrust bearings. Felt wipers protect the rest slides from grit and chips and the longitudinal feed screws have full length covers to protect them.

The bed is of the box type, heavily ribbed and of sufficient length to permit the longest trailer axle to be carried on centers and the operations of quartering and crankpin turning to be performed.

An outside rest for use in turning the journals of trailer sets can be furnished. In Fig. 1 this rest is shown in a vertical position where it is out of the way when turning inside journals. A pneumatic device is used to raise and lower this rest. The mechanism consists of an air cylinder, the piston rod of which is connected by means of a swivel joint to a projection on the rest. By turning a control valve the rest can be swung up into a horizontal position and held in place with two bolts on the rear of the rest.

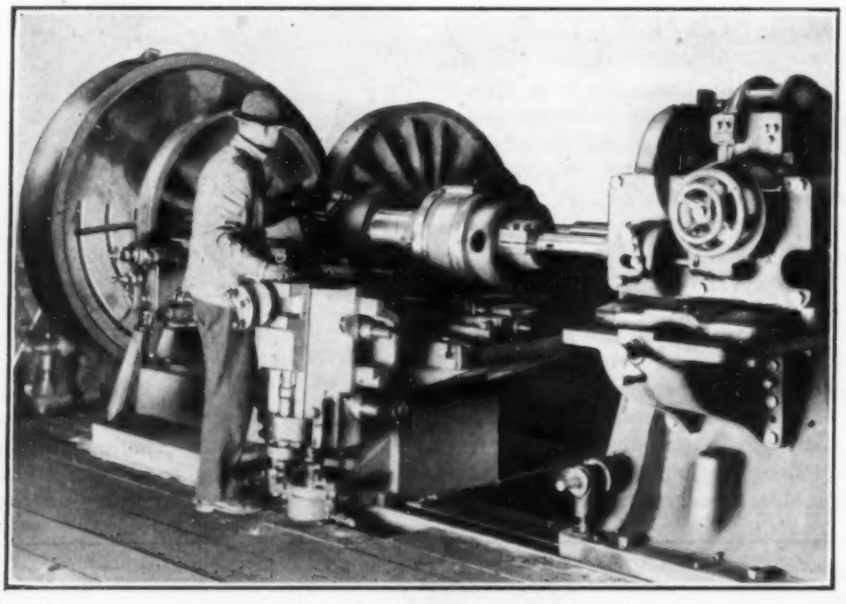

Fig. 3—Crankpin-turning attachment

For direct current the machine is driven by a 15-hp. 220-volt motor of 3-to-1 speed variation. An automatic controller and a push-button station are provided. For alternating current the machine is driven by a 15-hp., 220-volt, 3-phase, 60-cycle constant-speed motor with a compensator. Four faceplate speeds are provided through the speed box. The speed changes are controlled by a lever on the front of the headstock. A friction clutch makes it unnecessary to stop the motor when changing speeds.

A special tailstock is required to support the quartering attachment, and the outer end of the boring bar is supported on an adjustable base. The adjustment allows holes corresponding to crank radii of from 11 to 20 in. to be bored. For double quartering an additional attachment is provided for the headstock with the same adjustments as on the tailstock.

The crankpin-turning attachment is shown in Fig. 3. This device is a box tool that is clamped to the boring bar of the quartering head, and therefore the same adjustments for variable crankpin throw are available. When the machine is used for either quartering or crankpin turning, the wheel set is held rigidly on V-support benches the height of which may be adjusted by a screw with a worm and wormwheel drive. The wheel set is first supported on centers and then the supports are elevated until the journals rest on the V's. The centers are then withdrawn. When the wheels have been positioned, they are clamped in place by means of straps.

The swing over the bed of the machine is 90 in. The maximum distance between centers is 13 ft. The face plate is 72 in. in diam. The carriages are designed to turn journals up to 22½ in. in length simultaneously, but not less than 6 in. in diam. Hub liners may be faced up to 24 in. in diameter.

Columbia "JFS" Variable Speed Transmission

The Columbia Vari-Speed Co., 4020 W. Lake St., Chicago, Ill., has placed on the market a variable speed transmission for attachment to any machine motor-drive. The unit, shown in the accompanying illustration, consists of a special form of roller bearing with a constant speed input-shaft rotating on the inner

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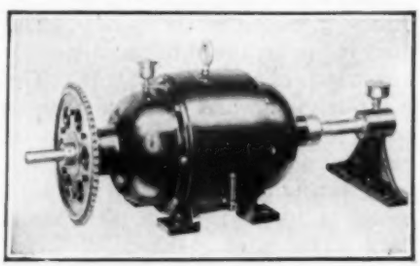
races of the bearing. The outer races are held from rotating, but are moved axially as the speed control wheel on the left of the frame is turned. In this way the points of contact of the rollers and races are shifted, and variation of the speed is effected.

The pressure between the rollers and races is supplied by springs, and is somewhat less than that of plain roller bearings. The rollers and races are of chrome-vanadium steel, hardened and ground. The housing is entirely enclosed, and is designed to be dirt and moisture proof.

The "JFS" speed transmission acts as both a speed reducer and a clutch. It is intended to be employed without any other transmission equipment



Columbia "JFS" Variable Speed Transmission

between the motor and the machine. While the constant speed shaft continues to run, the variable-speed shaft may be started or stopped under full load by the same handwheel that regulates the speed. The transmission unit is offered in eight standard sizes from ¼ to 7½ hp., but specifications for larger sizes are furnished on application. The sizes up to ¾ hp. weigh 90 lb., from 1 to 3 hp., 185 lb. and from 5 to 7½ hp., 325 pounds.

"Mann" Master Controller for Electric Arc Welders

The Electric Welder Controller Co., 602 Bigelow Blvd., Pittsburgh, Pa., is marketing the "Mann" master controller illustrated. It is said that the apparatus prevents spattering when a small globule of metal momentarily short circuits the arc, and that pores and pinholes in the welded metal are eliminated.

The controller consists of a combined choke and reactance coil. The coil has 128 turns of wire and the core consists of nearly 5,000 soft iron wires. This unit can be introduced directly into a 35-volt circuit of constant potential without the use of additional resistance units. The resistance drop when 300 amp. are

"Mann" Master Controller for Electric Arc Welders

flowing is two volts. The electrode can be held in contact with the work from one-tenth to one-eighth of a second before the current rises above 300 amp. Hence the current does not rise abnormally when a globule of metal momentarily short circuits the arc and no explosion takes place that forces the gas bubbles back into the weld, thus making it porous.

The controller weighs 420 pounds.

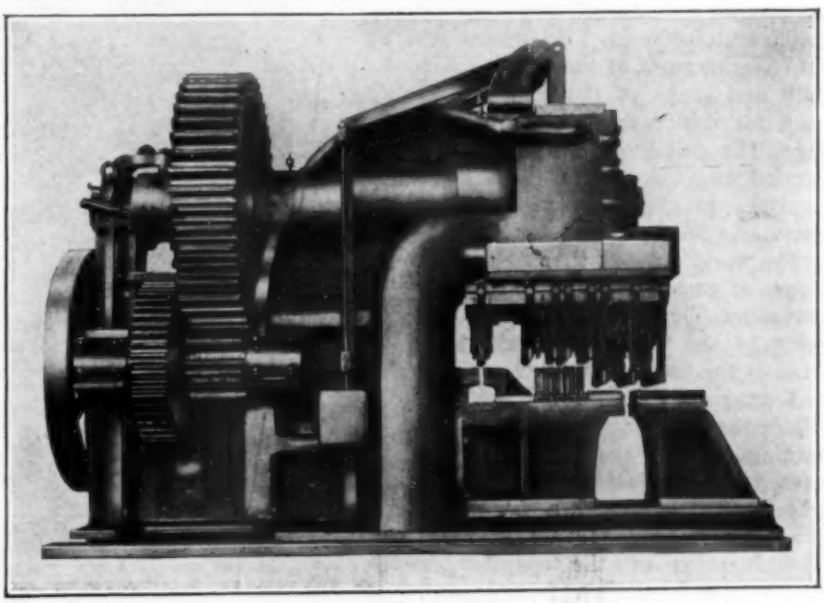
Cleveland Open-Gap Punching Machine Heavy-Duty

An open-gap punching machine that will punch both the flange and the web of steel beams without changing the tool set-up has been brought out by the Cleveland Punch & Shear Works Co., Cleveland, Ohio. The machine can also be used for punching plates. It is claimed to be the largest open-gap punch ever built.

The capacity for punching is for from 8 to 30 in. on Bethlehem girder beams, and on Bethlehem H-beams ranging in size from 8 to 14 in. By placing an overhanger at the rear of the throat standard 6- to 9-in. H-beams and standard I-beams may be punched without changing other set-ups of tools.

The punching tools are arranged in three standardized rows parallel to the main shaft. With the distance between the rows fixed, connecting angles can be punched with the same set-up as employed for the webs and flanges. The punching tools are hand gaged and are adjustable for from a minimum of 2¼ to a maximum of 48 in. apart. The strippers are also adjustable and may be set up to clear the flange and web without change. The stripper arms are attached by a single bolt.

The frame is a solid I-beam casting. The drive is of the double-gear



Cleveland Open-Gap Punching Machine, Heavy-Duty

Shop Equipment News

type, and an automatic clutch is employed to prevent a repeat stroke. The gears are made of steel with cut teeth, and the jaw plate for the gears is a separate steel casting tongued and bolted on. All gears rotate on bronze bushings. Instead of an overhead counterweight, there are two counterweights, one on each side at the rear of the throat, these being guided by vertical rods to steady them.

The machine is driven by a direct-connected 40-hp. motor. The height of the machine is 15 ft. and 3 in. The length is 15 ft. and 9½ inches.

Detroit Centerless Grinder, No. 5-C

The Detroit Machine Tool Co., 6545 St. Antoine St., Detroit, Mich., has placed on the market its centerless grinding machine, No. 5-C, shown in the accompanying illustration for full or semi-automatic, shoulder or straight-through grinding. The machine is similar in its general construction to the type No. 4-C grinder previously described on page 479, volume 62, of the *American Machinist*.

The machine has a cam shaft to control the various movements in the grinding operation. The cam controls the grinding wheels and is also the means for timing and feeding the work to the machine. The cam shaft is set in motion by means of a hand lever engaging a clutch. When this clutch is engaged the machine will repeat constantly a cycle of operations turning out from five to eighteen pieces per minute according to the work to be ground and the finish desired.

The grinding-wheel cam has been designed so that it can be adjusted to take any depth of cut between 0.005 and 0.020 in. By means of this arrangement of the cam the full path and shape of the cam can be used for either roughing or finishing. The grinding wheel spindle is carried on an eccentric quill 7¼ in. in diam. to provide means for the automatic feed.

The work is fed to the machine by means of an automatically controlled magazine. The grinding wheel moves down to the work, oscillating endwise at the completion of the stroke and returns to the loading position. While the grinding wheel is in the loading position the piece that has been ground falls from beneath the wheel and out through a chute, and the next piece falls into position. The function of the operator is chiefly to keep the magazine loaded.

In cases where production is not large enough for a full-automatic operation, a semi-automatic fixture can be used. This fixture is designed to take care of any length of work under the head from 1 to 8 in. and is mounted on the machine simply by tightening four studs and attaching a chain. The operator places the work on the loading finger, moves the lever toward him so that the work will be injected between the wheels and at the same time brings the camshaft into operation for one complete cycle. While this piece of work is being ground another piece is placed on the finger and the same operation performed as described above. When the camshaft is set in motion by the hand lever, which engages the clutch, the operator may return the lever to the original position after which the camshaft makes one complete revolution, automatically disengages the clutch and stops.

The No. 5-C machine will handle shoulder work ranging in lengths up to 8 in. under the head. It will also handle straight work ranging in diameter from ⅛ in. up to 4⅝ in. and lengths up to 16 ft. For lengths exceeding four or five feet special work-supporting fixtures are required. Grinding wheels having a diameter of 18 in. and a 4-in. face, and having a hole 10 in. in diam. are furnished as standard equipment. They are clamped between two flanges which adapt them to the taper on the grinding wheel spindle. The machine is arranged to accommodate any width of wheel up to 8 in. The work-driving wheel is made from a hard composition designed to furnish friction with no abrasive action for rotating the work. The standard wheel is 10 in. in diam. and has a face 8 in. wide. Where shoulder

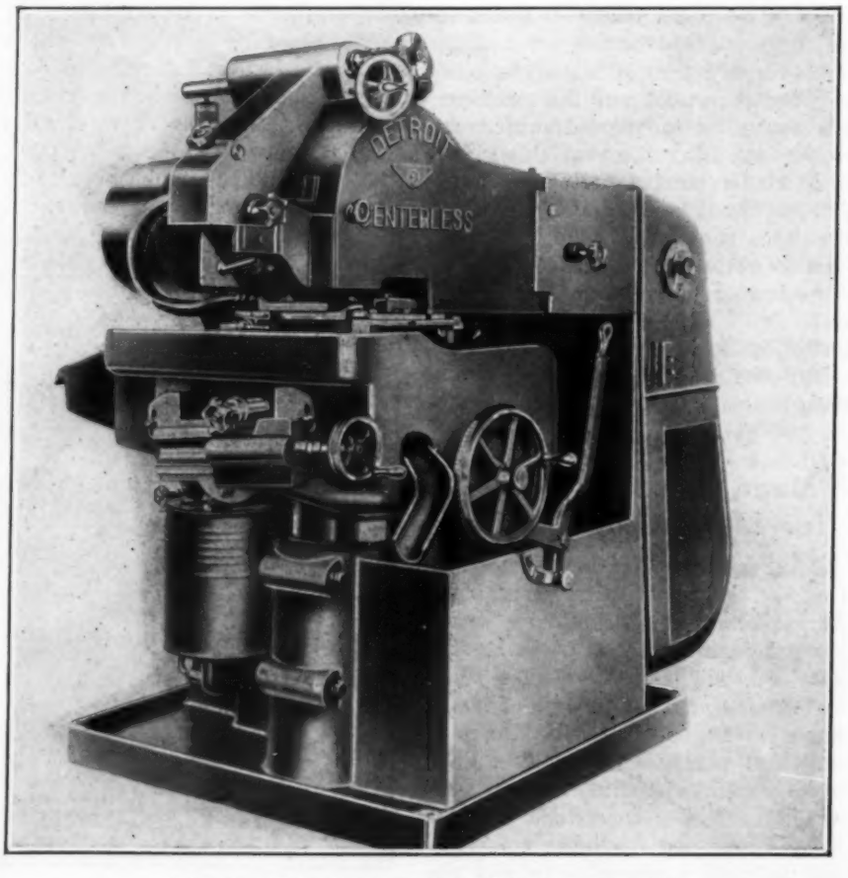


Fig. 1—Detroit Centerless Grinder, No. 5-C

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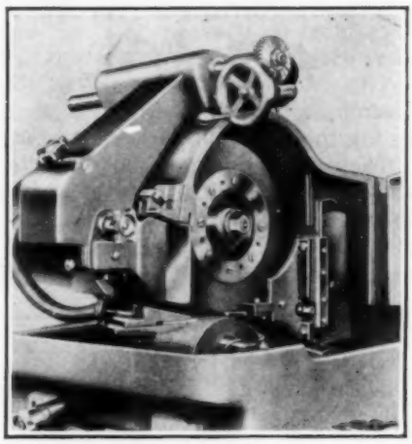

Fig. 2—A View Showing the Arrangement of the Wheels

work is to be ground under 8 in., a driving wheel is supplied to take care of the corresponding width of work.

The hardened and ground upper spindle is supported on the wheel side by a phosphorus bronze bearing of 3½ in. in inside diameter and 10 in. long. On the pulley end there is a 6 in. heavy roller bearing which takes the full belt pull. The front bearing has a taper take-up with an adjusting nut located at the end of the bearing. The bearing is lubricated from a central oil reservoir and a steady stream of oil runs through both bearings while the spindle is in motion. The spindle-driven pulley is 10 in. in diam. and has a 5½-in. face. The driving wheel runs in bronze bearings 6¾ in. long and 2¾ in. in diam., lined with high-pressure nickel-alloy babbitt. These bearings are lubricated from oil reservoirs with oil rings. The upper and lower wheel-truing devices are constructed as part of each grinder. Diamonds are extra and are not furnished with the machine. Both wheels can be trued without disturbing the set up of the work in the machine.

An 80-gallon tank that is cast integral with the base of the machine holds the grinding coolant. A centrifugal pump, easily accessible pumps the mixture directly on the work as it is being ground. Means for straining the coolant are provided. The machine is entirely electrically driven. A variable speed a.c. motor, the power for which is obtained from a generator on the machine, drives the feed wheel. A set of five-step cone pulleys is mounted in the base of the machine, providing five to eighteen cycles per minute. When the machine is to be used for straight-through work the variable-speed motor provides a wide range of speeds for various conditions. The machine is equipped for a.c. drive, but if 230 volt d.c. current is available the generator can be eliminated. The driving-wheel spindle is driven by means of a 15-hp. motor, which is placed on the back of the machine together with a starter box and the generator. The machine is regularly equipped with two mounted and balanced grinding wheels 8x4x 10 in. in size, one work-driving wheel, one set of work-guide blades, wheel-dressing attachments, one ¾-hp., variable-speed, motor for the driving wheel, a coolant pump, rheostat, switch, drive pulley, piping and the necessary wrenches.

Blanchard Vertical Surface Grinder No. 16, Improved

The Blanchard Machine Co., 64 State St., Cambridge, Mass., has improved its No. 16 vertical surface grinder of the direct motor-drive type. The general appearance of the machine is indicated in Fig. 1, while

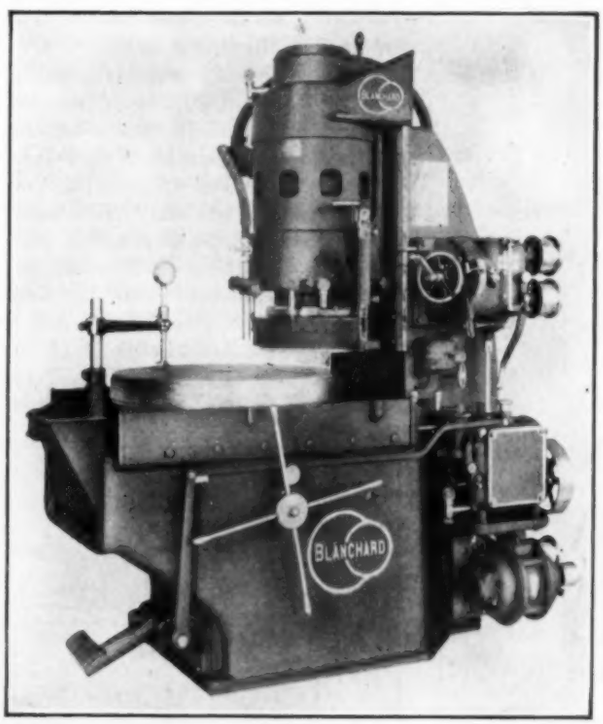

Fig. 1—Blanchard Vertical Surface Grinder, No. 16, Improved

a cross-section of the motor unit and a view of the rotor proper are shown in Figs. 2 and 3, respectively. The improvements have been made in the mounting of the spindle.

A single Gurney radio-thrust ball bearing is used in place of the thrust and the radial ball bearing at the upper position. The outer race of this bearing is held in a cartridge against which springs act in an upward direction. The thrust applied in this manner is sufficient to overcome the rotor weight and in addition to impose a considerable thrust load on the lower bearing. This thrust is intended to eliminate initial looseness and to prevent further axial yield when the grinding load is imposed. A dam arrangement about the shaft forms a reservoir for oil beneath the bearing, and a rotating flinger acts as a centrifugal pump to elevate the oil to the ball bearing. A Gurney radio-thrust bearing is also used in the lower bearing location in place of the tapered bronze radial bearing and the ball thrust bearing formerly used. This bearing is considerably larger than the upper bearing, but it is lubricated in a similar manner. This method of lubrication is said to result in small oil consumption, and, because of the reservoir capacity, refilling is needed only after long intervals. The spring construction makes it unnecessary to make bearing adjustments on the spindle.

The bearings are completely in-

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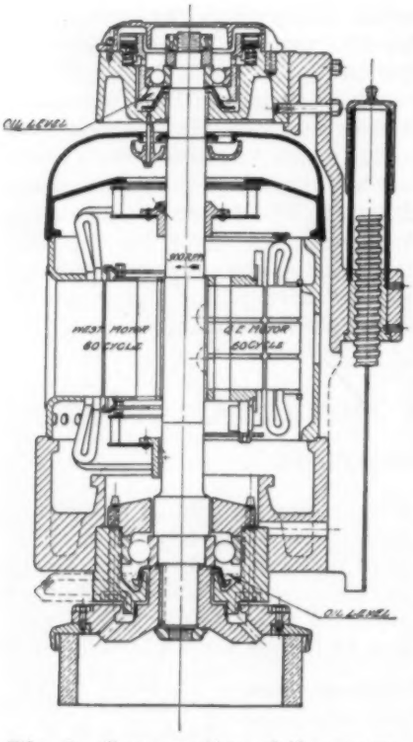


Fig. 2—Cross-section of the motor spindle

closed in order to prevent the entrance of dirt and water. The coolant passage has been simplified so

Fig. 3—The ball-bearing rotor

that it can be easily cleaned. The wheel guard has also been changed. It is fastened directly to the head, and the spider casting formerly used on the No. 16 grinder has been eliminated on this machine.

Heald Internal Grinding Machine No. 72, Special

The Heald Machine Co., Worcester, Mass., is building its No. 72 internal grinding machine with a special long bed to adapt it to grind holes in workpieces up to 22 in. in length. The work may be held in a standard three-jawed chuck or in a special fixture fitted to the spindle nose; in either case being supported at the outer end in a center-rest.

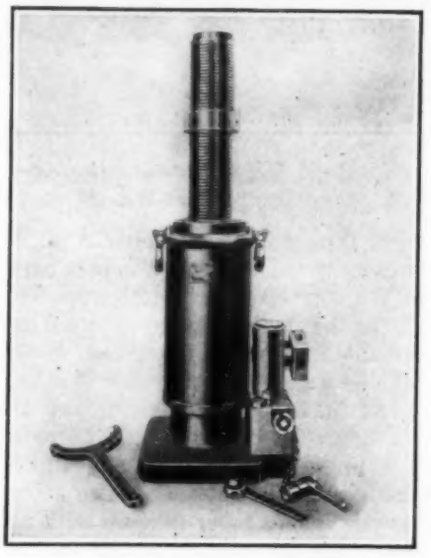
If so ordered, a special workhead with a hollow spindle may be substituted for the regular workhead. The through hole in the spindle may be of any desired diameter up to 6 in., and when so fitted the position of the piece may be reversed. In this case the work is held within the spindle by special fixtures and the center-rest may be dispensed with.

The wheelslide and traversing table are the same in every respect as the corresponding parts of the semi-automatic machine of this type previously described on page 33, Vol. 63, of the *American Machinist*, though this machine does not include the automatic sizing features of the latter. The machine can be furnished for belt or direct motor drive. The extra length available is 18 in. The floor space covered is 118x50 in. and the net weight is 5,000 pounds.

Watson-Stillman "Hydroscrew" Jack

The Watson-Stillman Co., 42 Church St., New York, N. Y., is marketing the hydraulic jack illustrated.

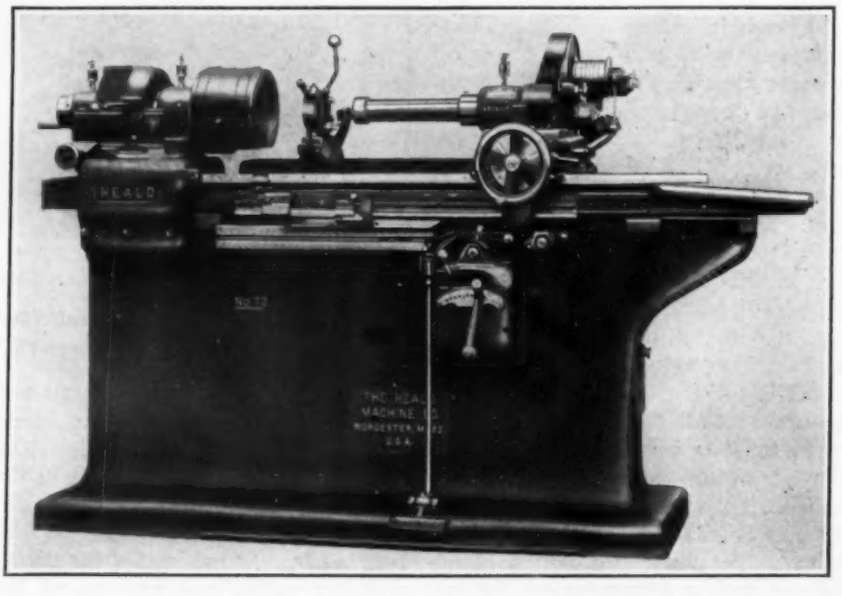
The jack is compact and light in weight. All working parts, of which there are five, and the valves are outside the main plunger body and hence are accessible. The oil filling



Watson-Stillman "Hydroscrew" Jack

is held in a reservoir that is said to be leak-proof. No refilling is required so that there should be no chance for dirt to get into the system and clog the valves.

The ram is threaded and is pro-



Heald Internal Grinding Machine No. 72, Special

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vided with a safety nut to hold the load in any position indefinitely. The ram cap is a separate piece and may be furnished in several lengths to give a height of jack ranging from 20½ to 42 inches.

The jack is made with two capacities: 20 to 40 tons and 40 to 75 tons.

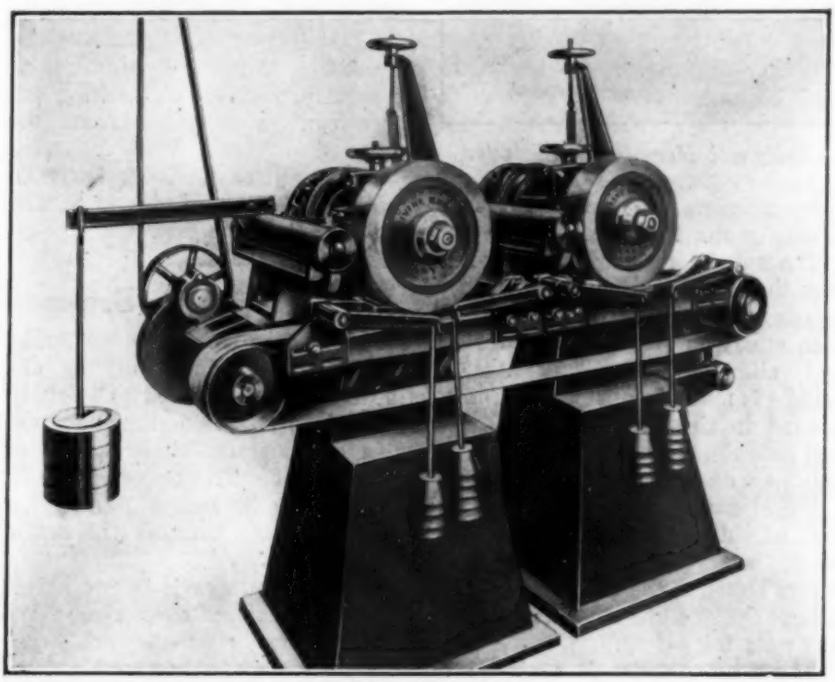
Divine Brothers Automatic Polishing Machine

The automatic polishing machine shown in the accompanying illustration has been placed on the market by the Divine Brothers Co., Utica, N. Y., for the automatic polishing of flat stock and flat surfaces. It is claimed that the automatic features of the machine greatly reduce the production time required for the work.

The material to be polished is placed on a feed belt that carries the work under a series of polishing wheels where the process is completed mechanically. Contact between the work and the polishing wheels is maintained by means of a micrometer adjustment. The wheels are both weight and spring balanced to secure delicacy of pressure.

Each polishing wheel is driven by an independent direct-drive motor. The machine is built in individual units, each carrying a wheel. They can be arranged in a battery to suit the requirements of the work. Additional units can be arranged in connection with the battery previously set up.

A variable-speed transmission provides for feed-belt speeds of from 5 to 25 ft. per min. The belts will accommodate pieces from thin sheets to several inches in thickness. The machine is built with various widths of feed to take pieces up to 20 in. or more wide.



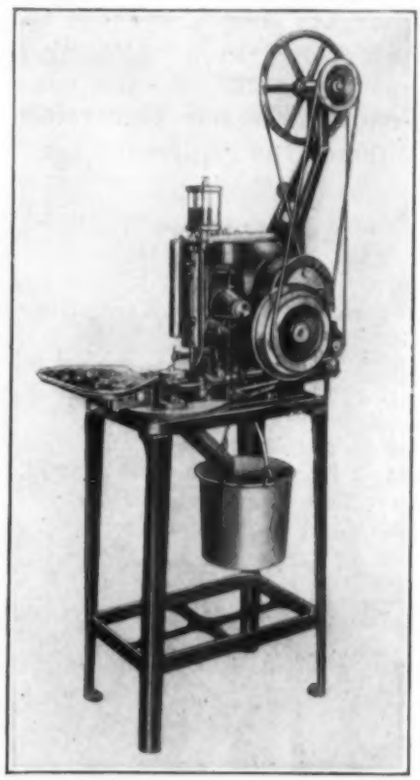
Divine Brothers Automatic Polishing Machine

Hart & Hegeman High-Speed Automatic Tapping Machine

An automatic tapping machine designed for high-speed production work has been placed on the market by the Hart & Hegeman Manufacturing Co., Hartford, Conn. The machine, shown in the accompanying illustration, is especially intended for small sheet-metal parts that are difficult to jig for the tapping operation.

The tapping spindle is driven by a three-step cone pulley giving 45, 65, or 85 strokes per min., which is equivalent to the normal number of holes that can be tapped per minute. For special work, however, the speed can be increased, and the only limit to the speed of production of brass parts is claimed to be the ability of the operator to feed the parts into the dial. The normal spindle speeds are 1,350, 1,950, and 2,550 rev. per minute.

The spindle is operated by a large spur gear keyed to an auxiliary spindle. The gear is wide enough to allow for the up-and-down travel of



Hart & Hegeman Automatic Tapping Machine

the spindle pinion. The tap is carried by a second spindle in line with the first, and driven from the first by means of a square sleeve having a telescoping connection with the tap-holding spindle. Pressure for starting the tap into the work is supplied by a compression spring inside of the square driving-sleeve. When the tap strikes an obstruction it will compress this spring, and be released instead of breaking.

The machine uses dials of three diameters, 6½, 8½ and 10½ in. The dial is rotated by a pawl which engages the notches in the dial. A safety clutch is provided in order to stop the tapping spindle if the dial does not index properly. The knock-out mechanism on the left of the machine pushes the piece down

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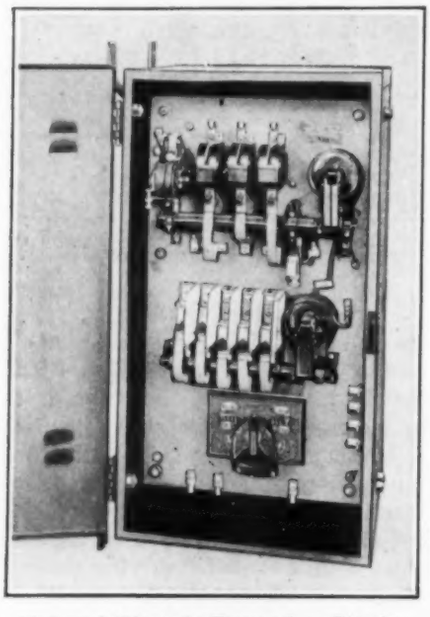
through the feeding dial after the tapping is completed and is adjustable to apply the pressure on any part of the piece.

Collets are furnished to hold taps up to ¼ in. in diam. A large sight-feed oil cup supplies lubricant for the tap. The machine is built for either bench or floor use, and is furnished with motor or countershaft drive. The shipping weight of the machine, complete, is 440 pounds.

General Electric Reversing Starter for Squirrel-Cage Motors

A reversing starter of the primary resistance type is being marketed by the General Electric Co., Schenectady N. Y., for use with squirrel-cage induction motors.

Two three-pole line contactors are provided with this starter. These contactors are electrically and mechanically interlocked and are mounted back-to-back on the panel. A magnetic interlock provides a predetermined definite time ranging



General Electric Reversing Starter for Squirrel-Cage Motors

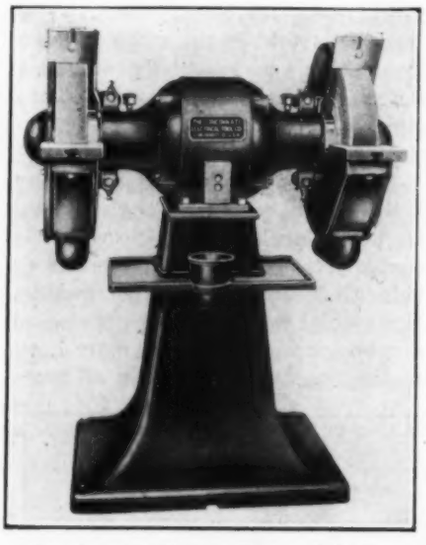
from one to three seconds between the closing of the line contactor and of the accelerating contactor.

Two-point starting is provided by a resistor designed to conform to Electric Power Club classification No. 16. A temperature overload relay with an external resetting mechanism furnishes overload protection.

The inclosing case is made of sheet metal and is semi-ventilated. It is provided with feet for wall mounting. When mounted, the panel occupies a position at right angles to the wall. There are doors at both the front and the back of the panel.

Cincinnati Heavy-Duty Grinders

Two heavy-duty grinders, one of which is shown in the illustration, have been placed on the market by the Cincinnati Electrical Tool Co., Madison and Edwards Roads, Cincinnati, Ohio. The grinders are driven by fully-inclosed 2- and 3-hp. electric motors, respectively. They are intended especially for service as



Cincinnati Heavy-Duty Grinder

floor grinders in railroad shops, foundries and factories.

The spindle rotates on ball bearings that are mounted in dust-proof housings and locked to the shaft in such a way as to provide end thrust and eliminate shaft wear. The spindle is made from steel accurately ground to size. The wheel flanges and nuts are machined so as to be in balance with the spindle.

Wheel guards of the exhaust type and adjustable to allow for wheel wear, are provided. Removable covers bolted to the guard completely inclose the side of the wheels, flanges and nuts for safety.

The 2-hp. grinder is equipped to carry 12x2x1¼-in. wheels, and a 3-hp. grinder carries 14x2¼x1¼-in. wheels. Motors can be had for alternating current of 220 or 440 volts, 25 to 60 cycles, 2 or 3 phase, or for direct current of 115 or 230 volts.

Baum's Bench Lever Press

The bench lever press illustrated has been placed on the market by Baum's Metal Specialties, 1523 Wyandotte St., Kansas City, Mo., for the punching, forming, and blanking of light metals, where a portable bench press is desirable.

The press has a capacity of 5,000

Baum's Bench Lever Press

lb. pressure and will blank sheet metal 3/32 in. thick with a cut edge of 6 or 7 in. It will punch holes in sheets ⅛ in. thick. Small dies can be used on the press when it is to be used for forming or bending, and these can be obtained from the company.

The length of the lever is 36 in. The height of the press is 11 in. and its weight is 35 pounds.

Clark Magnetic Brake

The "Three C" magnetic brake illustrated is being built by the Clark Controller Co., Cleveland, Ohio. The unit is designed for use with d.c. motors, either series or shunt wound. The brake is applied mechanically by means of a spring and is released through the action of a solenoid.

The brake proper is in two halves that give contact over almost the entire drum circumference. The lining is made of asbestos reinforced by brass wire. One end of each

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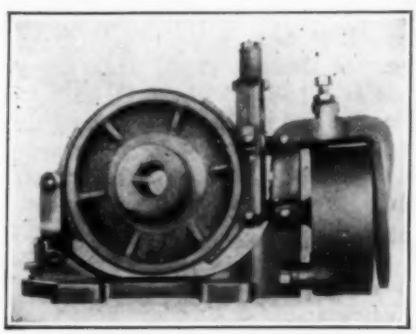
brake sector is connected to a common floating pivot point, and the other ends are pulled toward each other by means of a helical spring that acts between an inner and an outer yoke connected to the upper and lower bands, respectively. The pressure exerted by this spring can be varied by means of a screw-adjusted plug.

When the brake coil is energized the armature closes on the magnet case, which has a brass cover to prevent the armature from sticking due to residual magnetism. An adjustable stud on the armature arm bears down on a pivoted bar, the opposite end of which is connected to the upper brake half. The bar also has a gear sector integral with it, that actuates a similar mechanism connected to the lower brake half. Hence both halves simultaneously lift away from the drum an equal amount against the spring pressure. As soon as the armature is released the brake is set by spring pressure. It is claimed that the design is such that the armature does not rebond when the brake releases and that there is no hammer blow when the brake is set.

It is claimed also that a comparatively low unit pressure on the wheel is obtained that results in long life of the bands and the absence of scoring on the drum surface. Many of the parts can be readily inspected or dismantled without disturbing the various adjustments.



Clark Magnetic Brake

All castings are made of steel. The smallest machine has a wheel 8 in. in diam. and is rated at 15 hp., at 2,500 r.p.m. The largest machine has a wheel 24 in. in diameter and is rated at 150 hp., at 840 r.p.m. The corresponding continuous-duty torques are 45 and 900 foot-pounds.

Baker Truck With Lifting Magnet

The crane truck illustrated is equipped with an electric lifting magnet. It is being manufactured by the Baker-Raulang Co., Cleveland, Ohio. The truck may be operated inside of a standard box car and was designed to pick up loose castings on the car floor and to place them in skid boxes. It can also handle bagged material as shown in the illustration, provided it contains iron or steel.

The crane is known as type S-477 and it has a rated capacity of 1,000 lb. at a 40-in. radius. The truck wheelbase is 40 in. and the tread is 30 in. The driving wheels are 20 in. in diam., while the trailing wheels are 15 in. in diam. All four wheels steer so that the turning radius is small.

Baker Truck with Lifting Magnet

The power for operating the travel and hoisting motors as well as the magnet is supplied by a gas-electric unit manufactured by the Ready-Power Co., Detroit, Mich. A 4-cylinder Continental engine, governed at 1,000 r.p.m., drives a compound-wound ball-bearing generator by means of a silent chain. The output of the generator is 250 amp. at 30 volts, while the engine output is 15.62 hp. The motor is water cooled with pump circulation. It has magneto ignition and also an impulse starter.

The magnet is 20 in. in diam. and is designed to operate on 1,320 watts. The magnet controller is mounted on the dash next to the hoist controller. The magnet is made by the Ohio Electric and Controller Co., Cleveland, Ohio.

When the magnet reaches the top of its travel an automatic cutoff opens the hoist motor circuit. An automatic interlock also opens the travel motor circuit when the operator leaves the driving platform. It is impossible to secure power again without returning the controller to the neutral position. The hoist may be slewed by means of conveniently located handles, and a lock is provided to hold the hoist in its central position.

"Acme" Nonshatterable Eye Shield

The "Acme" eye shield shown in the accompanying illustration is manufactured by the Chicago Eye Shield Co., 2300 Warren Ave., Chicago, Ill., especially for attaching to grinders, lathes or to other machines in order to protect the eyes.

Non-shatterable glass 7x9 in. in size is used in the shield. The shield is mounted on a flexible arm so that it can be adjusted to any desired

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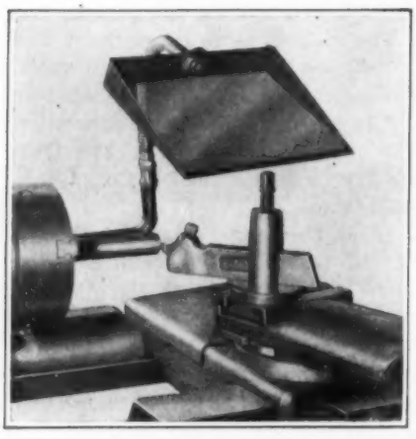


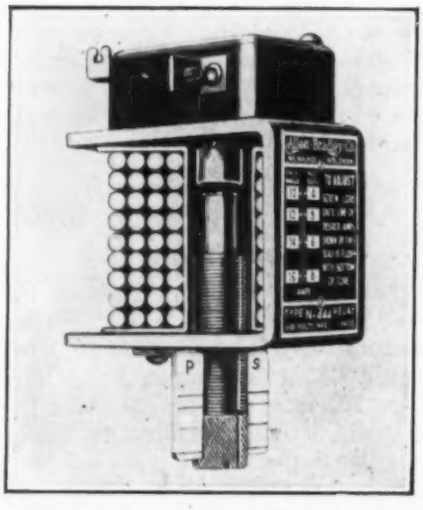
"Acme" Nonshatterable Eye Shield

position. The flexible arm is 12 in. long. It has, also, a 6-in. bent iron arm, adjustable steel brackets, a steel frame, pipe and lock nuts. A lamp attachment can also be provided for mounting on the arm near the shield.

Allen-Bradley "Inducto-Therm" Relay

The Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis., has developed the thermal relay, illustrated, to be used as the protective unit on some of its standard a.c. switches and starters.

The contact mechanism is maintained in a closed position by means of a reset lever which can be seen to the left at the top of the illustration. The lever engages with a ratchet wheel that is soldered to the vertical pin of the copper thermal element. This element can be seen above the adjustable coil in the center of the sectional view. The motor current flowing through the large magnetizing coil surrounding the adjustable coil creates a pulsating magnetic flux in the latter and this flux induces eddy currents in the thermal element by transformer action.



Allen-Bradley "Inducto-Therm" Relay

If the current flowing through the relay exceeds a predetermined maximum, the magnetic flux in the core becomes sufficiently dense to heat the copper thermal element and to melt the solder which holds the ratchet wheel. The ratchet wheel then turns and opens the relay contacts. As soon as the motor current is interrupted, the thermal element cools and the solder automatically sets, holding the ratchet wheel and ready to repeat its performance. The relay contacts, however, must be reset by hand after the ratchet wheel has again become fixed.

The adjustable magnetic core can be raised or lowered according to the scale beside it so as to vary the current at which the relay will trip and can be adjusted over a range as from 1 to 5 hp. for a given voltage. All intermediate horsepower ratings can be obtained without changing the thermal element. The same type of relay can be used for larger horsepowers.

Trent Electrical Melting Pot, Portable

The electrically-heated melting pot, illustrated, is being made by Harold E. Trent, 259 North Lawrence St., Philadelphia, Pa. The unit is portable and is particularly designed for maintenance work on babbitt metal bearings. The nonportable style of pot was described on page 798, Vol. 63, of the *American Machinist*.

The heat supplied to the pot may be controlled by a switch. Three stages are available for temperatures ranging up to 1,000 deg. F. The heating elements are of the Chromolox embedded type and are positioned so as to heat rapidly. The elements are insulated against heat loss to the outside by means of a refractory material between the crucible and the casing.

The casing is made of sheet steel and is finished with aluminum paint. The crucible and flange are cast in one piece from a selected iron that is resistant against the antimony in babbitt and type metals. It is claimed that the design is such that heating strains are avoided. Two raised ribs in the flange act as a spout when pouring. The crucible is 6 in. in diam. and its capacity is 45 lb. of metal.

Trent Electrical Melting Pot, Portable

The pot operates on either a.c. or d.c., 110 or 220 volts. Special pots can be had for 440 and 600 volts. The power consumption is 1.2 kw. Type B-45 is supplied with 4 ft. of armored Ovalflex cable, while Type P-45 is supplied with 10 ft. of flexible wire and a plug connector. This latter type is illustrated. The overall dimensions are 10 in. in diam. and 8 in. in height.

Pamphlets Received

Learning a trade at Pratt and Whitney. Published by the Pratt & Whitney Co. Division of the Niles-Bement-Pond Co., Hartford, Conn. This pamphlet is directed particularly to the one who contemplates an apprenticeship as a machinist, molder, core maker, or pattern maker. The booklet contains thirty-two, 6x9-in. pages devoted to such subjects as the choice of a job, the importance of machine tools, learning to be a machinist, learning to be a pattern maker and the suroundings in which the apprentice will find himself at Hartford.

The courses given by the company are outlined in the booklet and the discussion of the training of the apprentice will be found interesting. The booklet is readable and profusely illustrated.

News of the Week

Automobile Builders Are Experimenting With New Methods of Gearing

Discussions at S. A. E. meeting indicate the effort being made to perfect rear axle driving mechanism

Those who arrange the programs for the summer meetings of the Society of Automotive Engineers have learned how to mix business with pleasure, so as to accomplish much and at the same time make the meetings seem like a holiday. The summer meeting of 1926, at French Lick Springs, Indiana, bore evidence of the skill acquired. Standdards and other committees met at breakfast, luncheon and dinner so that much of the routine work was put out of the way without cluttering up a general meeting. This made fewer meetings necessary and gave considerable time for a sports tournament.

President Thomas J. Litle, Jr., made a very brief address at the opening session in which he voiced his belief in the decreasing size of automobiles, feeling that there is a tendency toward smaller engines and higher speeds, as indicated by the last Indianapolis race. Greater use of light alloys, better steels and giving the engineer a freer hand to develop engines and cars will, in his opinion, greatly improve the whole motor car situation.

Variety of Subjects

The papers, scattered through the various sessions were: "Cushion Springs and Riding Qualities," by Walter C. Keys; "Instrumentation and Results of Riding Quality Tests," by Roy W. Brown; "Complementary Color Headlights," by K. D. Chambers; "Causes of Wear and Corrosion in Engines," by O. M. Burkhardt; "Volatility of Automobile Fuels," by T. S. Sligh, Jr.; "The Influence of Temperature, Fuel and Lubricant in Forming Engine Carbon Deposits," by W. A. Gruse, C. J. Livingstone and S. P. Marley; "Antifreeze Solutions and Compounds," by H. K. Cummings; "Hypoid Gears," by Arthur L. Stewart and Ernest Wildhaber; "The Automotive Worm Gear," by L. R. Buckendale; "General Results of the Co-operative Motor Truck Impact Tests," by James A. Buchanan and J. W. Reid; "Balloon Tires for Drop Center Rims," by B. J. Lemon; and "Indicating the High-Speed Multicylinder Internal Combustion Engine," by H. M. Jacklin. Extracts of a few of these papers will be given later.

Special interest was shown in the subject of gears for automobile drives, and from all appearances many builders are experimenting with worm gear rear axles. Just how much this is due to Stutz using the worm driven axle cannot be stated. For it will be remembered that other worm driven cars have come and gone, among them the Edwards-Knight. But we know more about worm drives than formerly and know how to make worms and worm gears better than ever before. The position of the worm, above or below the axles is being discussed, both from the standpoints of lubrication of the worm and also the effect on the height of the car body. Some advocate the worm below the wheel to allow it to run in oil while others claim this is not good because of its getting dirty oil and that the oil does not get between the surfaces, being scraped off as the worm revolves.

New Hypoid Gear

Combating the worm idea is the new hypoid gear of the Gleason Works that can be cut on the spiral-bevel gear generators. This is a form of bevel in which the pinion is placed either above or below the center line of the ring gear, anywhere from 1½ to 3½ in. and so secures a combined rolling action, as with bevels and a sliding action as with the worm gear. The chief advantages claimed are noiseless operation, increased load carrying capacity, the possibility of high reduction with comparatively small gears, long life and efficient operation.

Efforts have been made to simplify the design of the axle as a whole, including the lubrication of the bearings, the heat-treating of the parts and to the selection of improved materials for the parts to be made.

The question of oil dilution as a cause of wear and of corrosion is not new, but it was discussed at length in connection with the paper by Mr. Burkhardt which, among other things, pointed out the economic loss now entailed in discarding oil after 500 miles of running as is fairly common practice at present. There seems to be no question that contaminated oil may be rectified. Some even claim that engines run with less accumulation of dirt than with new oil and nearly all consider rectified oil as being equal to new.

The indicator exhibited and described by H. M. Jacklin, of the University of Ohio, at Columbus, attracted wide attention. It is claimed to be the only method by which positive composite indicator diagrams can be taken on high speed internal combustion engines. These diagrams show the power, offset and lower loop effect on engines of this class. In this device there is practically no inertia effect due to the mechanism of the pencil or of the drum. The diagrams are also available for immediate use without photographic or other process.

In brief, the device consists of a standard, slow-speed indicator with a 1¼-in. cylinder that is coupled direct to a part of the device that has inside it a small poppet valve that is opened for a very small interval of each cycle of the engine. When this is opened it completes a communication between the manifold of the engine and the indicator.

The drum motion is connected to a crosshead that is a replica of the engine piston but which moves through one stroke for each 800 strokes of the engine piston. This gives a very slow back and forth movement to the indicator drum, nullifying the effects of inertia. This reduction of 800 to 1 is secured by a very ingenious method.

In addition to the technical papers the meetings were enlivened by a talk on the advances and possibilities of chemistry in our everyday life by Chas. F. Kettering, in his usual entertaining manner. He pointed out that the prosperity of a country depended, not on thrift or saving, but on the ability to convert the greatest amount of material into things we need and want.

The Army Air Service at McCook Field sent over a Douglas cruiser piloted by Lt. V. E. Bertrandias, who landed on the golf course. Another plane, piloted by Lt. G. W. Goddard, also of McCook Field, came over from Dayton, Ohio, took photographs of the members grouped in large letters, S.A.E., developed and printed the pictures in the air and dropped them on the field in a comparatively short time. This is the method devised by Dr. S. M. Burka, of McCook Field, who did the photographing and developing himself.

The usual golf tournaments, tennis matches and sports of various kinds enlivened the afternoons while interesting talks, moving pictures on the lawn and dancing completed the festivities. The attendance was large, about 900 in all and all voted it one of the most successful of the many summer meetings.

Half Million for Air Commerce

Appropriations totaling $550,000 have been asked to carry out the provisions of the recently enacted air commerce act. Of the amount, it is proposed to spend $300,000 in the installation, operation and maintenance of additional lighted airways. The additional $250,000 is for administrative expenses. In addition, the Post Office Department is to transfer $425,000 to the Department of Commerce for operation and maintenance of postal airways.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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"THE average car," says the *Weston Leader* (Oregon), "costs the average car owner more than the income of the average farmer. Yet, the average farmer owns an average car. What's the answer?"

Apparently this observation was intended to be humorous but it states a paradox that American business men will do well to consider.

About a month ago we seemed to be entering upon what might be called a psychological depression. It was chiefly due to the vigor with which the distress of the Western farmers and the New England manufacturers was exploited. Both classes seemed to be very sorry for themselves and looked anxiously for sympathy.

But as time has passed and the expected contraction in business has failed to arrive, what might be called an optimistic skepticism has succeeded the artificially induced pessimism that was temporarily in the ascendant, and people are commencing to ask how communities that claim to be so poor can continue to spend so freely. The answer seems to be that the American people are more prosperous than they admit or realize and that the economic slack that may be taken up before the pinch of hard times can be felt is far greater than any one supposed.

This may account for the steadiness of the markets last week. Rubber is the only article that has declined and its weakness has been chiefly due to sales for foreign account.

The winter wheat crop is about made. The yield of spring wheat is still dependent upon the weather but the total production is currently estimated at from 785 to 800 million bushels as against 668 millions last year. The prospective supply is not, however, regarded as excessive and the market for both wheat and corn has been impressively firm.

The probability that a majority of the Senate will vote in favor of the Haugen Bill and so "pass the buck" on to the House and the President may have been a strengthening factor, but the stability of prices—to whatever it may be due—cannot be denied or ignored.

The same thing may be said of cotton. It is slowly creeping upward in the face of a large carryover and crop reports that are in the main favorable although excessive rains and low temperatures are reported from some localities.

Sugar has also shown remarkable stolidity in spite of heavy sales by those producers who want to convert their holdings into cash, and higher prices seem to be only a question of time.

The steel industry is also a little below par. It is said to be running at 80 per cent capacity, but nine furnaces were closed during May, and at the advance of $2 per ton announced by the Steel Corporation ten days ago, the demand for structural shapes is tapering off.

What's Doing in Industry

The month of June opened with a slightly better tone in the machinery and machine tool market. Sales for the first ten days of the period are ahead of those of the preceding weeks and the inquiry forecasts a good volume for the whole month. Railroads are particularly active as prospective purchasers of equipment.

The automobile industry centered around Detroit has opened up and two or three large expansion programs promise good orders for machine tools. The Chicago market is improving and the immediate future is bright. Cincinnati reports a fair volume of orders from a scattered area. Business is spotty in Cleveland.

In the New York district sales have shown a slight improvement and inquiries are very active. Buffalo reports an increase in orders for special machinery. Philadelphia is quiet, but railroads there are expected to place orders soon.

The latest report of the Department of Commerce shows that exports of machine tools for the month of April, this year, were about $100,000 more in value than those of the same month last year. There was a decided falling off in shipments of lathes and gear cutters, but an increase in drilling machines, sheet-metal working machines and small tools.

The prospect of good business all over the country is becoming more evident every day, and European conditions are the only clouds on the horizon.

The trouble seems to be that there is a real decrease in building. Statistics do not yet reflect it, nor do contractors admit it but in New York at least there are a good many building projects that seem to be in a state of arrested development, and the market for rented apartments is distinctly easier.

The bankruptcy of a Florida land company that sought to capitalize the social prominence of its promoters is also indication of returning sanity in the real estate market. The liabilities of $8,000,000 are, however, chiefly due to those who can afford to lose the money, and the incident is not expected to have any far reaching effect.

On the Stock Exchange it was entirely ignored as bonds moved upward and railroad stocks were confidently bought upon the belief that the Van Sweringen plan will soon be revived and approved by the Inter-State Commerce Commission. If these expectations are realized other consolidations will probably follow, and the speculative fraternity is becoming quite excited over the outlook.

A small sized boom in railway stocks would indeed be possible, were it not that the prohibition question is absorbing public attention. It promises to be the major issue in the Congressional elections to be held next November, and until then it will be the subject most discussed.

But the preoccupation of the country with prohibition cannot obscure its undoubted prosperity. The prospect of good business during the summer is becoming more definite day by day, and about the only clouds visible are those that are to be seen across the Atlantic.

In Poland the government has become a dictatorship. The same thing is true of Portugal. The French still seem unwilling or unable to cope with the financial problems that confront their government, and in England the coal strike remains unsettled. If it were not that America is becoming accustomed to the political turbulence that seems to be chronic abroad, these conditions might cause some uneasiness here. But thus far they have been without effect upon business in the United States, except as they have made the flotation of foreign loans more difficult.

The result may be an accumulation of unused bank credit here that will bring about more or less inflation. But this is as yet a remote possibility, and until it is more imminent it will probably be safe for American merchants and manufacturers to go full speed ahead.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Buffalo

With the exception of the electrical portion of the machinery supply business, dealers in Buffalo report business as uneven. Reports vary from bad to fair. However, some report an increase in the number of new inquiries in recent days. No great increase in business is expected before the summer vacation period, although many expect a return of good business later in the year.

The condition is not alarming in any sense. The last six months, as a whole, have been good, and business in the electrical division of the industry still keeps up. One firm dealing in electrical machinery and equipment reports May to be the best month of the year.

The demand for contractors' equipment is on the increase but is not as strong as it might be were the weather conditions better.

Cincinnati

A slightly better tone in the market of the past week is reported by the majority of machine tool manufacturers and selling agencies of Cincinnati.

The week's orders were well scattered over the country and were well diversified as to sizes and types of tools. One concern, however, reports that its business was best on the Pacific Coast. Inquiries were received from all sections during the week.

The sales of the past week consisted principally of single tools, most of which were purchased for replacement purposes, the buyers being industrial users of machine tools and general machinists. Railroads placed a few single orders and sent in a number of fair-sized inquiries. A few sales to concerns in the automotive industries are reported.

Manufacture was maintained at its former level and it is believed that orders on hand together with those coming in will prevent any necessity of reducing production. Business conditions are regarded as normal for the season. It is pointed out that general business is better than it was at this time last year.

Chicago

A better feeling has developed among dealers in both new and used machinery and machine tools within the last week. This is due, not so much to a better industrial demand, although that shows signs of improvements, as it is to an increasing number of sales to railroads, and to new inquiries which are being received daily for standard equipment from that source. The month of May with most dealers fell slightly behind April in the volume of business transacted.

The present situation as commented on by machinery men is optimistic, and indicates that the summer months will prove better in point of actual sales than previous months. Among the railroads which have come into the market within the last few days for equipment are the New York Central, and the Union Pacific, while the Chicago Great Western, the Chicago & Northwestern and the Belt Railroad of Chicago are making inquiries with a view to buying.

Among industrials, the International Harvester Co. still leads as a buyer, having recently placed some good orders. There has been an advance in prices of from 10 to 15 per cent on planers, and manufacturers of other standard tools are said to be considering advances of a similar nature.

By and large, the machine tool situation is regarded as on the up-grade, and dealers express the opinion that it will so continue, at least for the next three months.

New York

This market has taken on a slightly better tone with the opening of June. May business, when totalled up, proved to be fair and most dealers reported a volume ahead of April. June sales, to date, have been confined to closing of old quotations, but the inquiry market has picked up and gives promise of good business as soon as details are settled.

The General Electric Co. has issued a list calling for thirty-four tools of various types. These are to be used in the Buffalo and Philadelphia shops. The New York, New Haven & Hartford R.R., the D. L. & W. R.R. and the New York Central have also sent out inquiries, bringing railroad activity up to a fair stage. Large industrials have been active buyers, although no large orders have been placed.

The following list gives an idea of the trend of present buying: Four 4-ft. radial drills, three 53-in. boring and turning mills, one 62-in. boring mill, 1 jig borer, 1 vertical shaper, 2 profiling machines, four multiple-spindle drill presses, one 8-ft. plate bending roll, 1 vertical surface grinder and 2 automatic milling machines.

Philadelphia

Business in the machinery and machine tool line remained quiet in Philadelphia during the last few weeks, but the undertone of economic conditions indicated the approach of a better condition before long. There is a feeling among producers that the purchase of equipment by the railroads in larger quantities is not far distant, and inquiries received from industrial plants over a well distributed area are encouraging.

Nothing in the way of boom conditions is looked for, however, but the producers are basing their hopes more on a steady advance in volume. In the machine trade the plants in Philadelphia are averaging from 50 to 60 per cent of capacity in operation.

Employment conditions are reported satisfactory. In the small tool line business continued somewhat spotty, with a lower volume than had been anticipated earlier in the season.

Cleveland

No material change was evident in the local machine tool industry for the past fortnight. The market continues to be spotty, business in the automatic and planer division is fairly active, while other lines show slight declines in sales.

Orders consummated were chiefly for single pieces for replacement purposes, indicating that buying is proceeding on a hand-to-mouth basis. Inquiries are scarce and with a slight slowing up in general of factory production, no large amount of new business is expected in June.

A comparison of the sales curve for May of this year over a year ago shows the former as being slightly higher.

The used tool market is enjoying an era of prosperity, inquiries in several instances are going begging due to the inability to secure suitable tools.

Detroit

Some signs of increased buying on the part of automobile manufacturers have cleared the atmosphere to a certain extent, and some of the leading machinery and machine tool representatives in Detroit feel that business will pick up within the course of the next few weeks.

At present the various plants of the General Motors Corporation are buying in fair quantities. This week officials announced that a five-million dollar plant for the manufacture of the Pontiac car will be constructed at Pontiac. Since the car was first placed on the market last year it has been built at the plant of the Oakland Motor Co., at Pontiac, but the demand has made it possible to go ahead with plans for a separate plant. Of this five million it is estimated that three million will be spent for machinery and equipment.

Machinery for the new plants of the Chevrolet Motor Car Co. at Flint is being ordered. Something like ten million is being spent to increase production to 1,000,000 cars annually, and of this sum at least $6,000,000 will be spent for machinery and machine tools.

The Fisher Body Corporation is making plans for extensions and additions which will mean the placing in Detroit of some large orders of machinery and equipment.

The Oakland Motor Car Co. is adding 23,000 sq.ft. of floor space and more machinery at an expenditure of $225,000.

Ford engineers are revamping some departments at the Fordson plant and several sizable orders are expected soon.

Many of the rolling mills and foundries have been buying new equipment during the past few days, and a general undercurrent of optimism over the outlook for the last half of the year is prevalent.

What the Railroads Are Doing

Authority to assume liability for $5,013,000 of equipment trust certificates has been granted by the Interstate Commerce Commission to the Illinois Central Railroad. This amount is to apply on the purchase of four hundred 40-ton automobile box cars at $2,239 each; four hundred 40-ton automobile cars at $2,242.80 each; one thousand 50-ton drop-door gondola cars at $2,228 each; five hundred 50-ton drop-door gondola cars at $2,223 each; one hundred 40-ton automobile furniture box cars at $2,601 each; fifty 40-ton automobile-furniture box cars at $2,771 each; fifty steel-under-frame caboose cars at $2,840 each; 3 steel dining cars at $51,060 each; 5 steel baggage cars at $20,965 each.

Authority to assume liability for $5,654,000 of equipment trust certificates has been granted by the Interstate Commerce Commission to the Southern Pacific Co. This amount is to apply on the purchase of 23 three cylinder 4-10-2 locomotives at $87,708 each; 5 mountain-type 4-8-2 locomotives at $82,000 each; 1,100 box cars at $2,005 each; 500 drop-bottom gondolas at $1,848 each; 350 stock cars at $2,000 each; 300 flat cars at $1,667 each; 64 caboose cars at $3,203 each; 28 baggage cars at $20,671 each; 10 passenger coaches at $30,441 each; 6 baggage and postal cars at $24,650 each; 11 dining cars at $47,762 each; one locomotive ditcher at $32,846; one 40-ton locomotive crane at $19,867; one 25-ton locomotive crane at $15,630; one 160-ton wrecking crane at $48,824; two 50-ton Jordon spreader ditchers at $16,358 each; one rotary snow plow at $46,550.

Shortage of Working Capital and Credit Facilities Hamper German Industry

Export figures reveal United States as largest buyer of machine tools—Low prices cut profits

BY OUR BERLIN CORRESPONDENT

At the beginning of the current year hopes were entertained that the business situation of the German machine building industry would, in keeping with general business, improve. These hopes were based upon a number of indications, as for instance the fact that the wave of unemployment had reached its highest point and was slowly receding, and that the credit situation became somewhat easier, that the bankruptcy rate diminished and that the stock exchange took a hopeful attitude expressed in a very substantial rising of industrial stocks.

Expectations have, however, reached too far as is evidenced by the fact that at the end of May after a survey of five months the tone in business circles is decidedly pessimistic. The domestic market remains dull and although the monthly bulletins issued by the Society of German Machine Builders, which is the main organization of all branches of the machine building industry, proclaim a slightly rising tendency of the market, manufacturers and dealers maintain not to be able to notice an improvement. Although such assertions must not be taken too literally, it is a fact that no machine tool factory is working at full capacity and that quite a large percentage has to stretch work by interpolating vacant days. Even large factories work only 3 to 4 days per week which they consider preferable to reducing their working force.

CAUSES ARE MANY

The reasons of the slump are chiefly seen in the lack of working capital prevailing in most German metal-working enterprises, in the downfall of the German motor car industry, which is still in a distressful condition, and in the lack of impetus expected from the producers of natural wealth, agriculture, mining, iron and steel production. The building season also leaves much to be desired and the business expected from industries building machinery and appliances for the refining of natural products is largely absent.

INQUIRIES PLENTIFUL

The number of inquiries coming to machine tool manufacturers and dealers is by no means low, but actual sales are concluded with a great deal of difficulty because neither manufacturers nor dealers are in a position to allow credit. Manufacturers and dealers are unanimous in stating that a large demand for machine tools still exists, as the process of bringing working methods up to highest efficiency has not come to an end, but that buyers are handicapped by lack of capital to carry through their projects.

The same complaints are heard from importers of American machinery who see the largest impediment toward extension of business in the impossibility to grant easy terms to customers. If they were able to afford buyers substantial financial aid, the volume of business would materially increase. The chief demand with regard to imported machinery centers on single purpose machines not made in Germany, whereas standard machinery as long as it cannot compete with German prices is entirely and definitely out of the run.

These conditions are clearly reflected in the statistical figures of machine tool imports issued for the first three months of the year. The import of tools, which in the first quarter of 1925 was 916 tons and in the corresponding quarter of 1913 1,774 tons, had dropped to 526 tons. The value of machinery imported in 1925 during the period mentioned was 2,748,000 marks, and in 1926 1,448,000 marks, or about half. The United States is the least affected of all importing countries. The machine tool import from the United States dropped only from 350 to 321 tons.

EXPORTS RISING

The export returns of the German machine tool building industry present an entirely different picture. Judging from actual figures, the complaints universally heard of restriction to German trade in foreign countries, the handicaps placed upon export in countries with inflated currency, seem particularly unjustified. A more prosperous aspect as the export business of the German machine tool industry offers in the first three months of 1926 can hardly be imagined. The tonnage rose from 8,678 metric tons in the first quarter of 1925 to 20,208 tons in 1926 and has thereby surpassed that of 1913, Germany's record business year.

The value has not kept equal step and increased from 15 million marks in 1925 to only 28 million marks, whereas if it had increased in the same proportion it should have reached 38 million marks. In 1913 the price per ton of machine tools exported was 1,160 marks, in 1925 1,800 marks, and in 1926 1,400 marks. From this it must be concluded that the increase of export business has been achieved at a good deal of sacrifice in the way of prices. As regards countries with inflated money it is evident that the export to France has even increased from 499 to 538, that to Belgium from 321 to 746, and that to Italy from 1,136 to 1,839 tons. These figures do not include machine tools furnished on reparations account. Comparing the export figures of 1926 with those of 1925 an increase is seen in almost every case, largest in that of Austria-Hungary, the former Russian States, Great Britain and Spain. In many such cases the export has by far left behind that of 1913.

The most astonishing feature, however, is the increase of machine exports to the United States of America. It has multiplied compared with past years, even pre-war years, in an almost incredible leap from an average of 200 tons to 4,500 tons. The United States has thereby become by far the largest buyer of German machine tools. Spain is following closely behind, and Great Britain bought in 1926 almost twice as many machine tools as in 1913. The rise of machine tool export to the Austro-Hungarian successor states and to the countries composing the former Russian Empire is also notable.

Cost Conference Invites Business Executives

With a program built around the discussion of practical uses of costs in business management, the National Association of Cost Acountants will hold its seventh international cost conference at Atlantic City for four days—June 14, 15, 16 and 17. Headquarters will be at the Ambassador Hotel.

The main theme of the conference will be "How an Executive Uses Cost Information," and some of the speakers will be Howard Coonley, president of the Walworth Manufacturing Co., and also an executive of the Link-Belt Co., Nelson B. Gaskill, formerly chairman of the Federal Trade Commission; Ray Vance, president of the Brookmire Economic Service; and C. M. Finney, comptroller of the Worthington Pump and Machinery Corporation.

Other topics to be presented are: "The Uses of Standard Costs and Related Accounting Procedure," "Stand ard Cost Acounting—Design and Operation," and "Distribution Costs." A question box session will be presided over by C. H. Scovell, president of the association.

Western Engineers Honor Insull

Speaking before the 56th annual meeting of the Western Society of Engineers which conferred an honorary membership on him on June 2, Samuel Insull, utility magnate, presented a brief sketch of the vast field of opportunities that lies before the engineering profession in the future. He characterized Chicago and the Mississippi valley as the great industrial center of the world.

Mr. Insull was one of three to receive an honorary membership in the presence of 1,200 or more engineers in the grand ball room of the Palmer house. The others were Hon. Herbert Hoover, Secretary of Commerce, and Dr. Ralph Modjeski, whose latest piece of work is the Delaware river bridge, the longest suspension bridge ever built.

Apprentices Begin Hartford Course

Machinist apprentices classes have been started at the Hartford High School, Hartford, Conn., under the supervision of instructor Edwin F. Nelson. Considerable interest has been manifest in this course and though the class is comparatively new, 45 students have already enrolled. The list includes machinists' helpers from the following Hartford plants: Pratt & Whitney, the Underwood Typewriter Co., the Hanson-Whitney Co., New Departure Manufacturing Co., the Underwood Computing Machine Co., and the Hart & Hegeman Manufacturing Co.

Slight Increase in Exports of Machinery in April

Exports of metal-working machinery for April, with revised comparative figures for April, 1925, as compiled by the Department of Commerce, are as follows:

Exports	April, 1925 Value	April, 1926 Value
Lathes	$203,730	.....
Boring and drilling machine tools	89,784	.....
Planers, shapers and slotters	36,265	.....
Bending and power presses	45,162	.....
Gear cutting machines	70,017	.....
Milling machines	124,901	.....
Punching and shearing machines	18,009	.....
Power hammers	15,275	.....
Other metal-working machinery and parts of	477,719	.....
Engine lathes	.....	$66,813
Turret lathes	.....	22,696
Other lathes	.....	43,685
Vertical boring mills and chucking machines	.....	30,696
Thread cutting and automatic screw machines	140,241	77,150
Knee and column type milling machines	.....	57,175
Other milling machines	.....	89,883
Disk type gear cutting machines	.....	.....
Other gear cutting machines	.....	28,437
Vertical drilling machines	.....	21,524
Radial drilling machines	.....	9,959
Sensitive drilling machines	.....	3,163
Other drilling machines	.....	60,683
Metal sawing and cutting-off machines	.....	15,769
Shapers and slotters	.....	26,849
Planers	.....	9,508
External cylindrical grinding machines	243,573	73,800
Internal grinding machines	84,236	34,564
Metal-working tool sharpening machines	.....	41,129
Other metal grinding machines	50,144	46,194
Sheet metal working machines	.....	97,520
Plate metal-working machines	.....	3,815
Rod or wire-working machines	.....	9,447
Forging machinery	.....	107,688
Rolling mill machinery	.....	46,469
Foundry and molding equipment	95,705	154,407
Other power-driven, metal-working machinery and parts	.....	300,314
Other metal-working machinery (total)	345,924	500,870
Hand or foot operated metal-working machinery and parts	.....	4,491
Pneumatic tools	88,010	157,060
Other portable metal-working machines	.....	51,943
Chucks for machine tools	39,210	37,851
Reamers, cutters, drills, taps, dies, and other metal working tools	218,704	249,525
	$2,386,609	$2,481,077

Business Items

The Apex Machine Co. has moved into new quarters at 300 Davis Ave., Dayton, Ohio.

The General Iron Works, of Denver, Colo., will occupy its new machine shop about the middle of June.

The Cleveland Stamping and Tool Co., of Cleveland, has begun the liquidation of its business.

The Colorado Gear Manufacturing Co., will move into its new plant at 1361 South Broadway, Denver, on the first of August.

The Sullivan Machinery Co., of Chicago, announces the removal of its Northwestern sales office from the Hutton Bldg., to 120 South Lincoln St., Spokane, Wash. Robert T. Banks is manager.

The Harron, Rickard & McCone Co., of San Francisco and Los Angeles, has been appointed sales representative in California, Arizona and Nevada for the Stark Tool Co., of Waltham, Mass., manufacturer of lathes, milling machines and small tools.

The Cleveland Metal Lathe Co., of 2587 East Fifty-Fifth St., Cleveland, has been incorporated to manufacture metal lathes of all kinds, and other machinery. Incorporators are Walter J. Hughes, H. F. Hogan, A. Morgenstern, Walter Carmack and Morris J. Fishman.

The Chicago offices of the Pratt & Whitney Co. Division, Niles-Bement-Pond Co., of which concern D. S. Woods is the local representative, have been moved to the South end of the building in which they have been located at 33 S. Jefferson St. Entrance to the offices is now at 564 W. Monroe St.

The Arthur F. Way Co., Inc., 470 Tolland Ave., Burnside, Conn., manufacturer of machinists' tools, has discontinued operations and the plant has been leased. The Way company manufactured a line of electric drills, the rights to which have been sold to the Goodell-Pratt Co., of Greenfield, Mass., which will continue.

The Cecil R. Lambert Co., Inc., of Detroit, specialists in the design, manufacture and installation of conveying and handling equipment, announces that in order to identify its products and service with its name, that the latter has been changed to the Mechanical Handling Systems, Inc. The company's facilities for service are being increased by additions to its plant and personnel.

The Timken Roller Bearing Service and Sales Co. announces the following changes in its personnel: H. E. Gilmore will become manager of the St. Louis branch. The Omaha branch office, formerly located at 2524 Farnum St., now occupies larger quarters at 2240 Douglas St. Complete service stocks for distributors will be maintained. The management will continue under the direction of A. D. Hackim. The new home of the Los Angeles branch will be at 1361 South Figueroa St. G. W. Curtis has been promoted from industrial equipment engineer to district manager of sales, industrial division, for the Milwaukee territory. Mr. Curtis will work with R. W. Ballentine who previously has handled this territory. S. M. Weckstein succeeds Mr. Curtis as industrial equipment engineer. G. W. Richards and A. R. Spicacci are appointed assistant industrial equipment engineers.

Personals

C. P. KRAMER has resigned as Buffalo representative for the National Acme Co. He has not announced his future plans.

L. GERARD FIRTH has been appointed general manager of the Firth-Sterling Steel Co., of McKeesport, Pa., and R. S. Stevick has been promoted to be works manager.

GLEN TRESLAR, for several years manager of the Buffalo office of the Van Dorn Electric Tool Co., of Cleveland, has been appointed manager of the Chicago office of the company.

A. C. RIPBERGER has been appointed chief engineer of the United Alloy Steel Corporation. He will be in charge of all engineering, operation and maintenance, and plants of the company.

ROSCOE SEYBOLD, formerly manager of price statistics of the Westinghouse Electric and Manufacturing Co., has been appointed assistant to F. A. Merrick, vice-president and general manager of the company.

FRANCIS T. WEST, who has been Western manager in Chicago for the Watson-Stillman Co., of New York, has retired. He has been succeeded by J. F. Coyne, who is assisted by James T. Lee and John O. Clark. Offices are at 549 West Washington Blvd.

JAMES A. LUPFER, former manager of the Snow-Holly Works of the Worthington Pump and Machinery Corporation, at Buffalo, N. Y., has been assigned to the offices of the company at New York city to become technical advisor to the vice-president of the corporation.

DR. V. N. KRIVOBOK, associate in the bureau of metallurgical research of Carnegie Institute of Technology, has been awarded a grant of $500 by the Iron and Steel Institute of Great Britain to assist him in carrying out a photomicroscopic study of recrystallization of metals after cold-working.

GEORGE E. THOMAS has resumed his former connection as New England representative for the Gisholt Machine Co., of Madison, Wis. He has established headquarters at 80 Allendale Road, Hartford, Conn. Frank M. Nelson has again taken charge of Gisholt service in that territory, with headquarters at 24 Fairbanks St., Worcester, Mass.

Forthcoming Meetings

Iron and Steel Exposition. Annual exhibit of fuel, electricity, machinery and safety under the auspices of the American Society for Steel Treating, Hotel Sherman, Chicago, June 7, 8, 9 and 10. Secretary, Mr. Kelly, Empire Bldg., Pittsburgh, Pa.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

National Association of Cost Accountants. Seventh annual international cost conference, Ambassador Hotel, Atlantic City, N. J., June 14, 15, 16 and 17. S. C. McLeod, secretary, 130 West 42nd St., New York.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary. 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section, A.S.M.E., the mechanical engineering department of the Sheffield Scientific School, and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual production meeting, Hotel Sherman, Chicago, Sept. 21, 22 and 23. John Warner, manager of meetings department, 29 West 39th St., New York.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under Association. R. E. Kennedy, secretary, 909 the auspices of the American Foundrymen's W. California St., Urbana, Ill.

National Association of Manufacturers. Thirty-second annual meeting, Waldorf-Astoria Hotel, New York, Oct. 5, 6 and 7. George S. Boudinot, secretary, 50 Church St., New York.

National Safety Council. Fifteenth annual safety congress, Detroit, Mich., Oct. 25 to 29. A. A. Mowbray, director, 108 East Ohio St., Chicago.

The Weekly Price Guide

Rise and Fall of the Market

STEEL bars are up $2 per ton; sheets and wire continue weak; iron prices tend downward in the Pittsburgh district but remain firm at Birmingham. Mill quotations on bars are mainly at $2 per 100 lb., Pittsburgh, with $2.10 applying on single carloads or less. Shapes and plates hold at last week's maximum of $1.90 per 100 lb., f.o.b. mill. The decline in mill prices of steel sheets amounted to about 5c. per 100 lb. on blue annealed, 10c. on black and 15c. on galvanized, comparing present levels with those of May 28; the mill change was reflected in Cleveland warehouse quotations. Non-ferrous metals and scrap declined slightly during the past week, in the principal markets. Cotton waste (colored) and linseed oil dropped in Cleveland; furnace coke is a trifle lower at Connellsville.

(*All prices as of June 4*)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.26
Virginia No. 2	28.67
Basic	22.26
CHICAGO	
No. 2 Foundry local	22.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	21.27
Basic	21.27
Bessemer	21.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.35@2.40	3.89	3.15	3.50
No. 12	2.40@2.45	3.94	3.20	3.55
No. 14	2.45@2.50	3.99	3.25	3.60
No. 16	2.55@2.60	4.09	3.35	3.70
Black				
Nos. 18 to 20	2.95@3.05	4.30	3.65	3.90
Nos. 22 to 24	3.00@3.10	4.35	3.70	3.95
Nos. 26 and 27	3.05@3.15	4.40	3.75	4.00
No. 28	3.15@3.25	4.50	3.85	4.10
Galvanized				
No. 10	3.35@3.50	4.65	4.00	4.25
Nos. 12 to 14	3.45@3.60	4.75	4.10	4.35
No. 16	3.60@3.75	4.90	4.25	4.50
Nos. 18 to 20	3.75@3.90	5.05	4.40	4.65
Nos. 22 to 24	3.90@4.05	5.20	4.55	4.80
Nos. 26 and 27	4.05@4.20	5.35	4.70	4.95
No. 28	4.35@4.50	5.65	5.00	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	58%	45%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	55%	42%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ½	⅝	¾	⅞	1	1½	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18½	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb. *Flat, 3/16@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.12½
Tin, 5-ton lots, New York			61.75
Lead (up to carlots) E. St. Louis	7.50	New York	8.25
Zinc (up to carlots) E. St. Louis	7.00	New York	7.87½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	9.50	16.50	10.50
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.25	16.50	16.00
Copper bars, base	22.12½	22.12½	21.87½@22.12½
Copper tubing, base	24.25	24.25	24.25
Brass sheets, base	18.87½	18.87½	18.87½
Brass tubing, base	23.50	23.50	23.50
Brass rods, base	16.62½	16.62½	16.62½
Brass wire, base	19.37½	19.37½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.75	12.55	12.27
Solder (½ and ½), (case lots)	38.37½	40.00	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	75.25
Commercial genuine, intermediate grade	54.00
Anti-friction metal, general service	30.50
No. 4 babbitt (f.o.b.)	13.62½

Nickel, f.o.b. refinery, cents per lb.:

Ingots	31.00	Electrolytic	38.00
Shot			32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.75 @12.00	11.25	10.75@11.25
Copper, heavy, and wire	11.00 @11.50	11.50	10.25@10.75
Copper, light, and bottoms	9.50 @ 9.75	9.75	9.25@ 9.75
Heavy lead	6.62½@ 6.87½	6.50	6.00@ 6.50
Tea lead	4.50 @ 4.75	5.00	5.00@ 5.50
Brass, heavy, yellow	7.00 @ 7.25	7.25	7.00@ 7.50
Brass, heavy, red	9.25 @ 9.75	9.50	8.25@ 8.75
Brass, light	5.75 @ 6.00	6.00	6.25@ 6.75
No. 1 yellow rod turnings	8.00 @ 8.25	8.00	7.50@ 8.00
Zinc	4.25 @ 4.75	4.00	4.00@ 4.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.14	.12@.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb.	3.60†	3.35	4.25‡
Linseed oil, per gal., 5 bbl. lots	.84	.96	.87
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot. ‡In 425 lb. barrels

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	0415
Brass rods	per lb	.1662½	.1662½	.1587½
Solder (½ and ½)	per lb.	.3837½	395	.395
Cotton waste	per lb.	.13@.17½	.13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	55	.55	.55
Machine oil	per gal.	35	35	35
Belting, leather, medium	off list	40–5%	40–5%	30–10%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		2.75@ 3.00
Coke, prompt foundry, Connellsville	per net ton		4.00@ 4.50
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{7}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x½-in., 2c. each. Discount 70% for $\frac{7}{16}$-in and smaller and 65% for ½-in. and larger.
Case hardened ¼x½-in., 6c. each, less 50%

Rivets, button heads, ½-in., ⅝-in. 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ½-in. dia., 75c; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅝-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

La., Southport (mail New Orleans)—C. C. Elmer Tank & Boiler Works Inc., 700 South Alexander St., New Orleans—bending rolls, 10 or 12 ft. for bending ⅜ or ½ in. plate for proposed 110 x 200 ft. steel shop here.

Mass., Boston—D. R. Campbell Machine Co., 52 Purchase St.—additional equipment for machine shop.

Mass., Boston—Savoy Realty Co., Pemberton Bldg. — miscellaneous tools and equipment for proposed 3 story repair and service garage. Estimated cost $100,000.

Mass., Brookline (Boston P. O.)—Henderson & Ross, 209 Washington St., Boston miscellaneous tools and equipment for proposed 3 story garage and repair shop here. Estimated cost $500,000.

Mich., Detroit—Schieber Mfg. Co., 11762 Cloverdale Ave. (automobile specialties)—automatic screw machine, ½ to ¾ in. capacity.

N. H., Lebanon—N. D. N. Corp.—single stroke surface grinder, planetary milling machine, 10 in. rotary chuck, demagnetizer, swivel type magnetic chuck, back geared vertical miller, and occillating ball race grinder.

N. C., Wilmington—Atlantic Coast Line R.R., F. H. Fechtig, Purch. Agt.—new equipment for shops at South Rocky Mount. Estimated cost $100,000.

O., Columbus—Winfield S. Jewell Co., 246 North Fourth St.—2 drill presses, medium size for new service station.

O., Norwalk—Frederick Machine Works, Foster St., C. Frederick, Secy.—equipment for proposed addition to machine shop.

Pa., East Pittsburgh—Westinghouse Electric & Mfg. Co., Chamber of Commerce Bldg., Pittsburgh—milling machines, riveting machine, multiple spindle, drill press and shapers.

Pa., Johnstown — Bd. of Education — lathes, drill presses, milling machines, grinders, hack saws and planers for vocational department of school.

Pa., Philadelphia — Pennsylvania R.R. Co., Broad St. Station, S. Porcher, Gen. Purch. Agt.—6 ft. boring mill.

R. I., Providence—Liberty Tool & Gauge Co., Toronto Ave.—additional machinery for tool factory.

Ont., Barrie—Ruberarium Products Co., D. Miller, Mgr.—equipment for the manufacture of switchboards, radio and battery boxes and electrical lines, for recently acquired factory. Estimated cost $200,000.

Que., Mont Joli—Beaudet & Co.—machinery and equipment for proposed machine shop.

Que., Montreal — Aristide Pigeon, 815 Carriere St.—complete equipment for new auto repair shop and garage.

Que., Rivere du Loup—H. P. Monsarrat complete foundry equipment to replace fire loss. Estimated cost $75,000.

Opportunities for Future Business

Calif., Beverly Hills—Bd. of Education, is having preliminary plans prepared for the construction of a high school including 40 x 150 ft. shop, etc. Estimated cost $400,000. R. D. Farquharson, Security Bldg., Los Angeles, Archt.

Calif., San Pablo — Standard Sanitary Mfg. Co., 10th and Brannan Sts., San Francisco, manufacturers of plumbing fixtures, is having plans prepared for the construction of a 1 and 3 story factory. Estimated cost $500,000. G. W. Kelham, Sharon Bldg., San Francisco, Archt. H. J. Brunnier, Sharon Bldg., San Francisco, Engr.

Conn., Hartford—J. P. Nielsen & Sons, 86 Maple St., is receiving bids for the construction of a 2 story, 96 x 300 ft. garage on Washington St. Estimated cost $150,000. Noted Feb. 4.

Florida—Atlantic Coast Line R.R., plans the construction of a locomotive repair shop at Tampa, also shop facilities at St. Petersburg, etc. in connection with $5,500,000 expansion program. J. E. Willoughby, Wilmington, N. C., Ch. Engr.

Ill., Burnside—Illinois Central R.R., 135 East 11th Pl., Chicago, awarded contract for the construction of a 90 x 440 ft. inspection shop and 75 x 440 ft. repair shop, etc., here. Estimated cost $270,000. A. F. Blaess, Ch. Engr. Noted Apr. 22.

Ill., Chicago—Chicago Pneumatic Tool Co., 572 West Randolph St., will soon award contract for the construction of a 2 story, 50 x 160 ft. factory at Iron and 37th Sts. Estimated cost $45,000. A. Epstein, 2001 West Pershing Road, Archt.

Ill., Chicago—Crowe Name Plate & Mfg. Co., 17 North La Salle St., awarded contract for the construction of a 2 story, 25 x 100 ft. addition to factory. at 1749 Grace St. Estimated cost $40,000.

Ill., Chicago—Pheoll Mfg. Co., 5700 West Roosevelt Road, manufacturers of metal products, will soon award contract for the construction of a 1 story, 62 x 350 ft. addition to factory. Estimated cost $100,000. A. S. Alschuler, 38 East Jackson Blvd., Archt.

Ind., Anderson—Remy Electric Co., C. E. Wilson, Gen. Mgr., plans the construction of plant No. 5.

Ind., Kokomo—Kokomo Steel & Wire Co., awarded contract for the construction of a 75 x 615 ft. mill to replace fire loss. Noted June 3.

Ind., South Bend — Studebaker Corp., Main and Bronson Sts., plans the construction of a factory at Lafayette and South Sts. Estimated cost $55,000. Private plans.

Ky., Covington—Michaels Art Bronze Co., Scott St., awarded contract for the construction of a 4 story, 60 x 60 ft. factory. Estimated cost $40,000.

Ky., Maysville—The Ohio Valley Pulley Co., awarded contract for the construction of a 1 story, 60 x 300 ft. addition to factory. Estimated cost $50,000.

Md., Baltimore—Maryland Meter Works, Saratoga St. and Guilford Ave., manufacturers of water meters, is having plans prepared for the construction of a 6 and 7 story, 110 x 164 ft. factory. Estimated cost $250,000. T. W. Pietsch, American Bldg., Archt. H. F. Doeleman, 507 North Charles St., Engr.

Mass., Boston — Noyes-Buick Co., 857 Commonwealth Ave., will build a 2 story sales and service station on North Beacon St. Estimated cost $175,000. F. A. McSheffrey, c/o owner, Archt.

Mass., Brighton (Boston P. O.)—Warren Engineering Co., 50 Terminal St., Boston, Engr., is receiving new bids for the construction of a 2 story garage here, for Mack Motor Truck Co., 75 North Beacon St. Estimated cost $160,000. Former bids rejected. Noted May 6.

Mass., Reading—Light Dept., awarded contract for the construction of a 1 story, 60 x 100 ft. shop and garage. Estimated cost $50,000. Noted Apr. 22.

Mass., Somerville (Boston P. O.)—Pilgrim Motor Co., Walnut St., is receiving bids for the construction of a 1 story, 120 x 165 ft. repair and service garage at New Northern Artery, Fellsway East. Estimated cost $80,000. E. J. MacDonald, 77 Summer St., Boston, Archt.

Mo., Kansas City—U. S. Register Co., 350 West 5th St., will build a 3 story, 82 x 100 ft. factory and office. Estimated cost $55,000. Private plans.

Neb., Omaha — Metropolitan Utilities Dist., awarded contract for the construction of a 3 story, 139 x 172 ft. garage and service station at 20th and Center Sts. $228,366. Noted June 3.

O., Cleveland—City, E. S. Barry, Dir. of Public Safety, City Hall, will soon award contract for the construction of a 1 story, 80 x 85 ft. police garage on East 35th St. Estimated cost $150,000. H. Kregelius, City Hall, Archt.

O., Cleveland—Motors Realty Co., G. G. G. Peckham, Pres., c/o Ohio Buick Co., 1903 East 19th St., will soon award contract for the construction of a 3 story, 135 x 320 ft. sales and service station at Euclid Ave. and East 24th St. Estimated cost $600,000. W. S. Ferguson Co., 1900 Euclid Bldg., Archt. and Engr.

O., Cleveland — Rickersberg Brass Co., E. Rickersberg, Pres., East 37th St. and Perkins Ave., awarded contract for the construction of a 1 story, 120 x 236 ft. factory and a 1 story, 66 x 200 ft. foundry on Kelly Ave. Estimated cost $150,000. Noted May 20.

O., Cleveland — The White Motor Co., W. C. White, Pres., 842 East 79th St., had plans prepared for the construction of a 1 story, 150 x 160 ft., addition to factory. Estimated cost $80,000. W. S. Ferguson Co., 1900 Euclid Bldg., Archt. and Engr.

O., Piqua—Dept. of Public Work and Highways, G. F. Schletinger, Dir., is having plans prepared for the construction of a 1 story, 65 x 100 ft. garage and repair shop. Estimated cost $35,000. H. B. Briggs. Ohio-Hartman Bldg., Archt.

Pa., Meadville—Hookless Fastener Co., manufacturers of metal zipper locks, awarded contract for the construction of a 3 story, 60 x 300 ft. and 2 story, 50 x 200 ft. factory buildings. Estimated cost $300,000. Noted May 20.

Pa., Philadelphia—Keystone Auto Top & Body Co., 1420 Fairmount Ave., awarded contract for the construction of a 2 story, 60 x 140 ft. factory at 2325-2331 Fairmount Ave. Estimated cost $50,000.

Pa., Philadelphia—Schneider Bowman Co. Inc., 1612 Van Dyke, awarded contract for the construction of a 2 story, 100 x 100 ft. iron foundry at Van Dyke and Paul Sts. Estimated cost $50,000.

Pa., Wyoming—Wyoming Shovel Works, N. G. Robertson, Pres. and Gen. Mgr., awarded contract for the design and construction of a 100 x 200 ft. factory to replace fire loss to The Austin Co., 1015 Chestnut St., Philadelphia. Estimated cost $50,000.

W. Va., Benwood—Wheeling Steel Corp., I. M. Scott, Pres., Wheeling Steel Corp. Bldg., Wheeling, awarded contract for the construction of a continuous skelp mill at plant here. Will have 14 roll stands, 12 in. diameter.

Wis., Green Bay—Brown County Motors Inc., 610 Main St., awarded contract for the construction of a 3 story, 75 x 172 ft. garage. Estimated cost $100,000.

Wis., Janesville — Fisher Body Corp., W. S. Knudsen, Gen. Mgr., General Motors Bldg., Detroit, Mich., is having plans prepared for the construction of a 1 story, 150 x 645 ft. factory here. Estimated cost $200,000. Private plans.

Wis., Mount Horeb—Mount Horeb Hardware Co., is receiving bids for the construction of a 1 story, 66 x 110 ft. service station and shop. Estimated cost $45,000. M. P. Schneider, 401 West Dayton St., Madison, Archt.

Wis., Wausau—Hammerblow Tool Co., 602 3rd St., plans to rebuild plant recently destroyed by fire. Loss is estimated at $100,000.